CIRCUS 2001

New Synergies in Digital Creativity Conference for Content Integrated Research in Creative User Systems

Glasgow, 20TH -22ND SEPTEMBER 2001

PROCEEDINGS

Due to a variety of issues (copyright, data formats, time constraints) not all articles were able to be included. Apologies for any conference presentations which are not represented with articles in these proceedings.

Compiled, edited and produced by Carola Boehm, David Garcia and Hubertien Schuter.
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The opinions expressed in these proceedings are those of the article authors and not necessarily those of the University of Glasgow

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ABSTRACTS AND PROGRAM NOTES

PROGRAM

Wednesday **19 Sept 2001**	
09:00	
10:00 - 13:00	**CIRCUS Internal Meeting** **Gilmore Hill Centre** **Room 408**
13:30	Lunch, in the coffee bar room
14:30 - 16:30	**CIRCUS Internal Meeting** **Gilmore Hill Centre** **Room 408**
18:15	Dinner: tba

Thursday **20 Sept 2001**		
09:00	Registration (and Coffee)	
10:00 - 11:00	***"Welcome"*, by Prof. John Caughie,** Dean of the Arts Faculty, U. of Glasgow **Keynote Talk:** **Trevor Wishart: Title tba** **Organisational:** The Conference Committee (Main Theatre)	
11:00 - 11:30	Coffee & Registration	
11:30 - 13:30	**Session 1A - Papers** **"Descriptions of Culture; Architectures of Information"** (Main Theatre) **Chair/Intro: Nick Bailey and Carola Boehm (Glasgow University)**	**Session 1B - Workshop** (with John Hopkins) *Networking and Creativity* (Room A)
11:40 - 12:05	1) Kia Ng, David Cooper and Bee Ong: *"Towards an integrated Handwritten Music, Manuscript Analysis and Recognition System"*	
12:30 - 12:55	2) L. Diaz, M. Kaipainen: Designing vector-based ontologies: *"Can technology empower open interpretation of ancient artifacts?"*	
12:05 - 12:30	3) Pamela Cruise, Michel Binkhorst, Jurriaan Schalken, Igor Burstyn: *"Modeling synergy within research groups through metadata analysis of content objects"*	
12:30 - 12:55	4) L. Diaz, M. Kaipainen: Designing vector-based ontologies: *"Can technology empower open interpretation of ancient artifacts?"*	
13:55 - 13:20	5) Duncan Marshall: *"'The English Earbook' and Creative Linguistics"*	

13:30 - 14:30	Lunch (Lunch Hall)

14:30 - 16:15	**Session 2AB - Papers** **" Interactivity and the future of the creative practice"** (Main Theatre) **Chair/Intro: Simon Penny (Portsmouth University)**
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15:05 - 15:30	2) Paul Modler, Tony Myatt: "*Video Based Gesture Recognition by Artificial Neural Networks for Interactive Music Systems"*
15:30 - 15:55	*3) Garth Paine: "Interactive sound works in public exhibition spaces, an artist's perspective"*
16:00 - 16:30	Tea
16:30 - 16:55	4) D.R.Lawrence, A. Gracie: *"Streaming sensor driven Midi - triggering remote interactivity"*
16:55 - 17:20	5) Silvia Gabrielli, Eric Harris, Yvonne Rogers, Mike Scaife, Hilary Smith: *"How Many Ways Can You Mix Colour? Young Children's Explorations of Mixed Reality Environments"*
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18:15 - 19:15	Dinner (Lunch Hall)

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20:00 - 21:30	**Cinematic and Music Performances** Concert Hall

23:00	BUS TO CENTRE (Allander Coach)	

Friday
21 Sept 2001

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10:50 - 13:30	**Session 4A - Papers** **"Theory and Methodology of digital creative production contexts"** (Main Theatre) **Chair/Intro: Helmut Draxler and Michael Dreyer (Merz Akademie)**	**Session 1B - Workshop** (with John Hopkins) *Networking and Creativity* (Room A)

11:00 - 11:25	1) Nicholas J Bailey: *"Why Free Software Happens: A Survey of Motivation in the Open Software Community"*	
11:25 - 11:50	2) Pedro Rebelo: *"On the Coherence of Sonic Space"*	
11:50 - 12:15	3) Steve Everett: *"Logics of Value for digital Music"*	
12:15 - 12:40	4) Matthew Chalmers (only Friday/Saturday): *"Theory and Practive in the City Project"*	
12:40 - 13:00	5) Oladele Bamgboye, David England, Yu Ming Tai: *"Unmasking 3 - A Framework for the Interactive African Art Museum"*	
13:00 - 13:25	6) Manuela Carlos: *"The Arctic Project"*	

13:30 - 14:30	Lunch (Lunch Hall)

14:30 - 16:15	**Session 5AB - Papers** **"Digital Cinematics"** (Main Theatre) **Chair/Intro: Malcolm LeGrice (London Institute)**
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15:05 - 15:30	2) Alex Butterworth and John Wyver: *"Interactive or Inhabited TV, Broadcasting for the 21st Century"*
15:30 - 15:55	3) Andrea Zapp: *"Digital Cinematics (the book)"*
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22:30	BUS TO CENTRE (Allander Coach)

Saturday
22 Sept 2001

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10:50 - 13:30	**Session 7A - Papers** **"Insitutional Support for Innovation or Creative Pull"** Main Theatre	**Session 1B - Workshop** (with John Hopkins) *Networking and Creativity*

	Chair/Intro: John Patterson (Glasgow University), Malcolm LeGrice (London Institute)	(Room A)
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11:25 - 11:50	2) John Patterson: *"Using the Web as a Pedagogical Tool"*	
11:50 - 12:15	3) Greta Mary Hair, John Gormley: *"Aquitanian Chant Notation: a Web-Based Tutor"*	
12:15 - 12:40	4) Aukje Thomassen; Emile Bijk: *"Knowledge Management in Design Education"*	
12:40 - 13:00	5) Pauline Donachy, Carola Boehm, Dr. Stephen Arnold, Karst deJong: *"MusicWeb Connect:: A European Project for creating web-based Tools and Resources for Music Education"*	
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14:00 - 15:15	**Session 8A - Papers (cont'd)** **"Insitutional Support for Innovation or Creative Pull" (cont'd)** Main Theatre **Chair/Intro: John Patterson, Malcolm LeGrice**
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14:25 - 14:55	7) Tim Putnam: *"Capability and Competitiveness in the New Creative Industries Education, Training and Competitiveness in New Creative Enterprise"*
14:55 - 15:20	8) John Hopkins: *"Feedback from the Workshop"*
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16:00 - 17:00	**Session 8AB - CIRCUS Round Table** **"Looking to the Future"** (Main Theatre) **Chair/Intro: Prof. Tim Putnam**
17:00 - 17:30	CIRCUS working group internal meeting (Room A)

18:15 - 19:15	DINNER and **END OF CONFERENCE** (Lunch Hall)

KEYNOTE SPEAKERS – ABSTRACTS AND BIOGRAPHIES

Trevor Wishart: Keynote Talk for the Opening of the Conference

Trevor Wishart

http://www.trevorwishart.co.uk/

Trevor Wishart is a composer who is widely respected internationally. He has held composer residencies in many countries, amongst them Australia, Canada, Holland, Berlin and the USA and the UK (York, Cambridge and Birmingham). His works are wide-ranging, from environmental music events through musical theatre works to major electroacoustic works. He has been involved in developments in creative music education and has written a number of books in the field. His works have been commissioned internationally and have won prizes at Gaudeamus Festival, Linz Ars Electronica and the Bourges Festival. He is currently Honorary Visiting Professor at the University of York, and an AHRB Research Fellow at the University of Birmingham. His contributions to the field of computer music include the two books On Sonic Art (1985) and Audible Design (1994), and a great number of original software tools for musical composition. He is a founder member of the Composer's Guild.

Bryan Pfaffenberger: "*Why classification matters: A political economy of computer-based metadata*"

One of the oldest of anthropological concerns is the cultural creation and appropriation of taxonomic or classification systems -- and, although theoretical debate still rages, a consensus has formed around what might be termed an indeterminacy principle: All classification systems amount to an attempt to shape as well as describe the world around us, and therefore amount to modes of political and economic as well as taxonomic action. This presentation recounts how Standard Generalized Markup Language (SGML) practitioners came (reluctantly) to a similar conclusion, and critically analyzes the risks involved in permitting multinational corporations, such as Microsoft, to shape classificatory agendas insofar as computing and Internet resources are involved. A strong appeal is made for more widespread use of noncommercial, open source computer and classification systems in educational settings.

Bryan Pfaffenberger

http://www.people.virginia.edu/~bp/

A recognized international authority on the Internet, Bryan Pfaffenberger is Associate Professor of Technology, Culture and Communication at the University of Virginia. He is currently teaching courses on "Intellectual Property and Digital Media" and "Social Issues of Information technology" including the phenomenon of music promotion on the internet. Bryan Pfaffenberger is the author of more than 50 books on personal computing and the Internet and has published a number of paper on relevant current issues such as

- "The Social Cost of Bogus Patents: Who Loses When British Telecom Gets a Patent on Hyperlinking? Linux Journal, forthcoming.
- "Open Source Software and Software Patents," Knowledge, Technology, and Policy, 12:3 (Fall, 1999), pp. 94-112.
- "The Internet in China," Linux Journal, November 22, 2000. Available online at http://www2.linuxjournal.com/articles/currents/0024.html.
- "Yes, Microsoft, This Really IS About Free Speech" [Analysis of Microsoft Corporation's use of the Digital Millennium Copyright Act (DMCA) to suppress unwanted criticism on an Internet site], Linux Journal, May 12, 2000.
- "Linux in Higher Education: Open Source, Open Minds, Social Justice" [Analysis of digital media licensing and its implications for traditions and values of free intellectual exchange in science, scholarship, and university teaching] , Linux Journal, March 21, 2000.
- Democratizing Information: Online Database Technology and the Rise of End-User Searching. Boston: G.K. Hall, Inc., 1990. Winner of the American Society for Information Science Best Book of the Year Award.

Markku Eskelinen: *"Ergodic Art and Computer Games"*

Abstract:

In order to be in harmony with at least some themes of this conference (taxonomies of interactivity and theories useful to practice) I'll expand and transform Espen Aarseth's cybertext theory and its insights of the unique dual materiality of cybernetic sign production into a functional cybermedia theory and then test its heuristic potential with and against influential conceptual contradictions inherent to the languages of new media (Lev Manovich), the post-human (N. Katherine Hayles) and comparative media studies (Henry Jenkins et al.). I'll also try to situate interactive or ergodic art among various interpretative and configurative practices while focusing especially on the relations between digital cinema and computer games

Markku Eskelinen

http://www.kolumbus.fi/mareske

Markku Eskelinen is an independent scholar and experimental writer of cybertext fiction, interactive drama, and critical essays. He is a co-editor of Game Studies – the international journal of computer game research (www.gamestudies.org) and a series of Cybertext Year Books (University of Jyväskylä, Finland). He has given paper and other presentations on cybertext theory and computer game studies at various international conferences, including the series of Digital Arts and Culture conferences, SIGGRAPH and the ACM conferences on Hypertext and Hypermedia. Excerpts from his earliest fiction were published in The Review of Contemporary Fiction (Summer 1996) according to which he' s "easily the most iconoclastic figure on the Finnish literary scene." A selection of recent and forthcoming publications in English:

- Cybertext Yearbook 2000. Co-edited with Raine Koskimaa. Jyväskylä: Research Centre for Contemporary Culture.
- "Discourse Timer – Towards Temporally Dynamic Texts". Dichtung Digital, June 2001 (with Raine Koskimaa) <http://www.dichtung-digital.de/2001/05/29-Esk-Kosk>
- "The Gaming Situation". Game Studies – the international journal of computer game research 1/2001<http://cmc.uib.no/gamestudies/0101/eskelinen/>
- "Cybertext Theory and Literary Studies". The Electronic Book Review (forthcoming in September/October 2001)

Scott deLahunta: "*Corporeal Technologies*"

Abstract:

The emphasis in computing science and engineering research is shifting to the body as the location for the pervasive, distributed, ubiquitous and mobile technologies of today and tomorrow. However, this shift doesn't tend to recognise the particularities of unique bodies, preferring to focus on social bodies, groups and communities of readers and users. This short article turns away from these patterns of connected and communicating [electronic] bodies to focus on the relationship between emerging technologies and the unique corporeality of the dancer.

Dance technique has assimilated new information from the fields of biology and physiology as well as transference of dancing knowledge across cultures. A short historical overview of theories and practices of dance technique in America and Northern Western Europe leads to the observation that the trained dancer is as culturally as they are physically constructed, each trained body a repository for a particular kind of information accumulated through time.

The article shifts to an analysis of aspects of the working process of a contemporary choreographer, William Forsythe. Forsythe takes the tradition of ballet as his starting point, but has used techniques for generating complex movement material and compositions that borrow heavily on computational processes – in particular the ways in which 'algorithms' can be used to generate emergent movement material both in rehearsal and improvisational performances. The dancers have been selected for the company on the basis of their unique physical and mental abilities that enable them to perform these complicated operations.

After looking at how inspiration for dancing and dance making may come from some of the processes of computation (as opposed to direct human computer interaction), the article considers the question: what if the unique body of the dancer were placed at the very centre of HCI research with the aim to enhance the environment for the instruction of the dancer? This proposal for a new 'smart studio' closes the article and brings it full circle by suggesting that such a project would spawn mutually beneficial collaborations between dance artists and computing science and engineering researchers.

Scott deLahunta

Scott deLahunta began in the arts as a dancer and choreographer. Since 1992, as a partner of Writing Research Associates (WRA), he has organised several international workshop/ symposia projects in the field of performance. In 1996, WRA organised Connecting Bodies, the first conference in the Netherlands on the theme of the overlap between dance and emerging technologies. From February-May 1999, Mr. deLahunta was a guest professor with the Department of Dramaturgy, Aarhus University, Denmark and co-organiser of the Digital Theatre xperimentarium, a project investigating the relationship between motion capture, animation and live performance. From 1998 to 2000, he was a consultant for the Laban Centre London on dance and technology applications and implementation. He is frequently invited to organise research, give presentations and contribute to publications on the overlap between dance and new media technologies. In Autumn 2001, with the support of the Arts Council of England, the WRA initiative *Software for Dancers* will conduct the first in a series of research labs/ thinktanks looking to develop new software tools for performance artists. Mr. deLahunta has been a Research Fellow at Dartington College of Arts since 1999 and is an Associate Editor for the Journal of Performance Research. Selected Project/ Consultancy/ Papers Links:

- Consultation Paper: Theatre/ Dance and New Media and Information, Technologies: Spring 1998 http://art.net/~dtz/scott3.html
- Digital Theatre Experimentarium, Aarhus, DK: Spring 1999, http://www.daimi.au.dk/~sdela/dte/
- University of California Irvine, Motion Capture Studio: Spring 2001, http://www.arts.uci.edu/lnaugle/html/mcs/
- Pre-Ground Work Research Report: Spring 2001, http://www.dartington.ac.uk/~s.delahunta/ace/gw/

Alex Butterworth and John Wyver: "*Interactive or Inhabited TV, Broadcasting for the 21st Century*"

Abstract:

There once was a time, known only anecdotally to the generation who are now rising to guide broadcasting into the new millenium, when television was a true prism of national communal life. In those golden days crowds would convene spontaneously on the terraced streets of our industrial heartlands the morning after a Wednesday Play or Play for Today had been screened, thrilling with vicarious passion and eager to discuss the personal and political significance of what they had seen. Debate would rage, government policy would be changed and broadcasting would be seen to have performed its public service. Or so we have heard.

For the beleaguered few who still harbour such memories it is little wonder that Interactive TV sounds frighteningly like the last trump for their ideals: heralding a bleak dystopia where the suckered mass of lonely viewers will be so narcotised as to commune exclusively with the shopping channel's hotbots. Indeed judging by the initial forays into interactivity by some broadcasters one might consider these fears well founded, though the kind of material so far produced only echoes the tendency towards the lowest common denominator in broadcasting more generally. But is it just possible that interactivity may not only rise above these concerns, promoting the creation of worthwhile and intelligent new experiences, but may at last even incarnate that very dream of communal participation?

WORKSHOPS – ABSTRACTS AND BIOGRAPHIES

🛠 John Hopkins – "Networking and Creativity"

This workshop will be an open dialogue focusing on contemporary and historical issues surrounding the use of technology in the sustained act of creativity. We will explore various aspects of technological and human networks as a locus for the creative transmission of dialectic human energy. We will examine the pathways and forms that this energy takes, as well as ways to direct concentration and attention into the communicative/creative act. In support of the CIRCUS concept, participants are asked to bring their reflections on CIRCUS both as a concept and as an actuality.

The workshop is not only about creative skills related to technological tools, it is about creating new paradigms for living and creating new ways of being. The primary goal of the workshop is to create a synergized and pluralistis dialogue that opens possibilities in the moment and in the future. The results will be shared with other attendees during a plenary session on Saturday.

John Hopkins

http://neoscenes.net

A native of Alaska, USA, Hopkins has taken the identity of a "tech-no-madic" artist and educator who is actively constructing alternative communicative spaces. Having a background in hard science, engineering, and technology-based arts, he applies the unique possibilities of network and communications technologies in his creative work. With solo exhibitions in 7 countries, he was included in the the ground-breaking "PORT: Navigating Digital Culture" exhibition in 1997 at the MIT Visual Arts Center in Boston, as well as at the Ars Electronica festival in Linz, Austria in 1997 and 1998 as part of the innovative Open-X networking venue. He is currently the coordinator for PNEK, a Norwegian cultural networking project. Formerly he was the Content Coordinator for a trans-European networking project "cafe9" which was part of the nine European Culture Capitals 2000 project. He has conducted many workshops and lectures at more than 30 major art/design institutions in 12 countries over the past six years.

ARTISTS – PROGRAM NOTES AND BIOGRAPHIES

Trevor Batten: *"Untitled Einsteinian Turing Machine"*

Installation

The work (in progress) is a real-time autonomous process with an infinite duration. At present, a quartet of wire-frame rectangles move autonomously and slowly over the screen, sometimes changing colour, as they modify and process their environment to determine their own movement and colour.

The work is currently under development, and at present is still silent. In principle, the present work is a continuation (in Java) of earlier work produced on the Amiga -which for technical and practical reasons has now been discontinued. Information regarding the earlier work can be found at <dma.nl/batten>.

Trevor Batten

Born 16.5.45 Hillingdon, England. Produced computer generated graphic image with the help of a friendly mathematician in 1967 while studying at Exeter College of Art. The lack of facilities in those early days lead to a multi-disciplinary approach via the Institute for Sonology, Utrecht (1972) which involved a search for visual applications of sonological (electronic- musicological) concepts. This approach lead to the "Cross Media Mapping" project, which eventually died through lack of external support. In 1987 the purchase of an Amiga computer financed by half a Work-grant from the Dutch Ministry of Culture enabled an experimental begin to be made (as an independent artist) with the development of dynamic autonomous audio-visual automata. This work is now being continued in the multi-platform language Java. Part-time lecturer at art colleges in Brighton (3-d foundation studies, 1968), Sunderland (printmaking, 1970/71) and Enschede (media art 1988/99). Has participated in various international conferences, seminars and festivals for electronic art.

Kim Cascone – *"Dust Theories"*

Interactive Performance Installation

"Dust Theories" I became interested in genetic algorithms while reading the book 'Artifical Life' by Steven Levy. I had developed some work last year in Max/MSP that enabled me to mix soundfiles that were randomly chosen for me but felt that I had too many moments of 'bad choices' being presented to me. I wanted to use some aspect of a-life to be able to solve this problem and decided to embark on exploring some ideas about constructing a 'search space' that I could navigate through while performing. The title 'Dust Theories' was taken from the book 'Permutation City' by Greg Egan and is a oblique nod to Mr Egan's concept of clandestinely borrowing code from other programs in order to create a new 'secret' program. This concept is also an extension of the idea of 'residualism' where I was using material that was left behind or tossed aside after use.

"Dust Theories" is a work in progress and is planned for release some time in 2001

Kim Cascone

Kim Cascone has a long history involving electronic music: he received his formal training in electronic music at the Berklee College of Music in the early 1970's, and in 1976 continued his studies with Dana McCurdy at the New School in New York City. In the 1980's, after moving to San Francisco and gaining experience as an audio technician, Cascone worked with David Lynch as Assistant Music Editor on both Twin Peaks and Wild at Heart. Cascone left the film industry in 1991 to concentrate on Silent Records, a label that he founded in 1986, transforming it into the U.S.'s premier electronic music label.

At the height of Silent's success, he sold the company in early 1996 to pursue his love of sound design and went to work for Thomas Dolby's company Headspace as a sound designer and composer. Currently he is working for Staccato Systems as the Director of Content where he oversees the design of new sounds for games using alrorithmic synthesis.

Since 1980, Kim has released more than 15 albums of electronic music and has worked as a collaborator and producer on numerous projects including Nurse With Wound, Keith Rowe, Merzbow, Haruomi Hosono among others. Cascone's compositions have been performed at the International Computer Music Conference (Ann Arbor), Lovebytes Festival (UK), Mutek (Montreal), Transmissions Festival (North Carolina), Send + Receive Festival (Winnipeg) and performed new work on a 6 city European tour last year. Cas-

cone was one of of the co-founders of the microsound list (http://www.microsound.org) and writes for Computer Music Journal (MIT Press) and Artbyte Magazine.

Wilfried Agricola de Cologne: *"A Virtual Memorial Memorial project against the Forgetting and for Humanity"*

Wilfried Agricola de Cologne

Wilfried Agricola de Cologne was born in 1950 in the Black Forest in Southern Germany and is living and working as a free lance media artist since 1984 in Cologne, Germany. His studies included the State Academy of Fine Arts, Munich University and Rijksakademie Amsterdam. Since 2000 he has participated in different media festivals, such as Sonar-Barcelona, File-Sao Paolo,

Videoformes-Clermont Ferrand, Lite Show-Boston with individuals shows since 1980. Between 1987-1998 12 major solo touring exhibition projects were realized in cooperation with more than 80 European museums. Since 1994 he is working with New Media and has presented Net Art Projects on several art bases, such as Rhizome.org. One of his latest work can be seen since 01-01-2001 online: NewMediaArtProjectNetwork including 6 corporate websites.

Steven Everett - *"OPAQUE SILHOUETTE"*

musicMusic/video Video Videoby Steve Everett

Created: 2000, Princeton, NJ and Atlanta, GA
Photos: 1880s Central Java, TropicInstitut of Amsterdam
Length: 14 minutes, VHS-NTSC (also available in DV-NTSC and DV-PAL)
Audio Tape: Stereo or 8-channel playback versions

This work is the opening section of a two-hour multimedia shadow play, KAM, for Javanese shadow puppeteer, gamelan and Western instruments, interactive computer electronics and video installation. It is based on a play, Ki Ageng Mangir by Indonesian author and political dissident, Pramoedya Ananta Toer.

This 14 minute video is an initial look into the inner world and torment of the play's main character, Princess Pembayun, daughter of the first sultan of the Mataram dynasty in Java (late 16th century), Senopati. She is deceived and manipulated by her father and consequently deceives her husband who is her father's arch enemy. In KAM, this complex struggle for truth, power, love, and honor is told in a traditional Javanese shadow play form with additional visual and computer musical elements added.

The composer has met with Toer on two occasions (1996 and 1997) in Jakarta to discuss this play and his projections on the future of his country. The play is a retelling of a sixteenth-century Javanese conflict, but the situations in Toer's adaptation are quite current. Individual recordings have been made of the gamelan sekaten instruments in Surakarta, Java dating from the 16th century, and analysis/resynthesis of their timbral spectra have been performed using the Kyma system. The resultant timbres then served as the basis for the construction of many of the vertical sonorities used in the composition. Original shadow puppets of the characters in the play have been created in Java for this production as well. The text is spoken and sung in English and Bahasa Indonesian.

Steven Everett

As a composer, many of his works involve interactive computer-controlled electronics with performers. These have been performed in over fifty concerts in Japan, Indonesia, Germany, France, England, Italy, Canada, and throughout the USA. Composition awards have been received from the Asian Cultural Council, Rockefeller Foundation, Chamber Music America, American Composers Forum, and Bogliasco Foundation.

He recently completed a music-drama shadow play, kaM, based on a work by Indonesian author and political dissident Pramoedya Ananta Toer, collaborating with Berlin installation artist, Andrea Sunder-Plassmann and Javanese puppeteer, Midiyanto. Recent premieres include Quiet Silence for marimba and live spatialization at Princeton University and Quiver Songs for shakuhachi and guitar performed by Yoshio Kurahashi in Kyoto, Japan. He is recorded on SCI, Crystal, Mark, and ACA Digital Records.

Active as a conductor of new music, he is co-artistic director and conductor of Thamyris New Music Ensemble in Atlanta. Now in its 15th season, Thamyris is comprised of players from the Atlanta Symphony Orchestra, has received the ASCAP/Chamber Music America Award for Adventurous Programming five years, and is ensemble-in-residence at Emory University sponsored by Chamber Music America. Everett has also guest conducted the San Francisco Contemporary Music Players and the Contemporary Chamber Players of Illinois. He has been awarded the Mayor's Fellowship in the Arts, by the City of Atlanta Bureau of Cultural Affairs for "outstanding contributions to the arts in Atlanta."

Lesley Keen: "BURRELLESQUE" and "RA, THE PATH OF THE SUN GOD"

"BURRELLESQUE", 1991 7 MINUTES, 35MM, DOLBY STEREO

Commissioned as part of the celebrations to mark Glasgow's year as Cultural Capital of Europe in 1990, Burrellesque is a light-hearted tribute to one of the city's best-loved galleries, the Burrell Collection. Burrellesque explores the possibilities of combining traditional and backlit special effects animation with photographs. The central idea is that the objects in the collection embody the spirits of the place and have a secret life playing in the park surrounding the gallery.

A Persistent Vision Animation production for Channel 4 and the City of Glasgow Festivals Office. Visit www.vegasqueen.com/burrellesque.htm for more background information on the making of the film.

"RA, THE PATH OF THE SUN GOD", 1990, (PART 2) 22 MINUTES, 35MM, DOLBY STEREO

Ra is a three-part 72-minute animated feature, exploring ancient Egyptian mythological themes and beliefs. To create a sense of other worldliness, the cosmological elements are drawn with coloured light in multiple exposures.

Part 2, Noon, explores Man's role in the divine order of the cosmos. The life of the Pharaoh, the living god, is depicted as a journey through the rituals surrounding his initiation into temple life.

A Persistent Vision Animation production for Channel 4 and the Scottish Film Production Fund.

Lesley Keen

http://www.vegasqueen.com/

Lesley Keen is a graduate of the Glasgow School of Art. Her professional career spans graphic design, animation and interactive media development. During the 1980s she made a series of highly experimental animated films for the Channel Four, including Ra and Burrellesque. In 1985 she was appointed as honourary research fellow of the computing science department of Glasgow University, to explore ideas related to computer-assisted animation. Having become completely 'corrupted' by the possibilities of the emerging computer graphics technologies LK founded Scotland's first multimedia company, which went on to develop a range of entertainment software for the consumer market. These days she is involved in web development and new media consultancy.

Kai Lappalainen: *"Giant Steps"*

Video - 4 min

The theme is here a bit more pessimistic, originally this was made for a Baltic Sea animation contest (pollution etc.) but the contest never took place.

Anyway, Giant Steps is a good sample of skilful animation and sound environment.

Kai Lappalainen

Kai Lappalainen, graduated in December 2000.

Malcolm Le Grice: *Films*

Malcolm Le Grice

Born 15 May 1940, Malcolm Le Grice studied painting at the Slade until 1964. In 1967 had first exhibitions as a film and video artist and started a film department at St Martin' s School of Art. In 1968 helped established the London Filmmakers Co-operative workshop. In 1969 had first exhibition of a computer work and first European film tour. Published theoretical/critical essays regularly from 1972 and ' Abstract Film and Beyond' (Studio Vista) in 1977. Continues to publish regularly on experimental film and digital arts. Frequent international tours, exhibitions and festival screenings since 1970 including shows at the Museum of Modern Art, New York, the Louvre, Paris, the German Filmmuseum, Frankfurt, The Art Gallery of Ontario, Toronto and film retrospectives at the ICA London and the Cinematheque Valencia. Televison screenings include Finnegans Chin (1983), Sketches for a Sensual Philosophy (1990) and Chronos Fragmented (1995).

Duncan Marshall: *"Paper World Room"*

Installation

Paper World Room was an installation for the CADE (Computers in Art, Design and Education) Conference 2001 and formed part of an exhibition at Glasgow School of Art, Renfrew Street. It took three days to set up (7 – 9 April), was on view for four days (9 – 12 April) and took three hours to take down (13 April). Hundreds of sheets of photocopied text were used to completely paper over the walls, floor and ceiling of a room measuring 6 metres long, 2 ½ m wide and 2 ¼ m high, creating a smooth white space covered with words.

The starting point was 17 A4 sheets of printed text. Each contained citations for a particular word from the Collins Bank of English, a 400m word research corpus of language gathered from sources including newspapers, books, magazines and transcriptions of radio programmes.

To create each sheet, a word was keyed into the Bank of English search engine and the first 70 or so instances of its usage, selected more or less randomly by the search engine, were printed out. The usages were all one line in length, with the chosen or 'node' word positioned in the middle of every line and forming a column down the middle of the page. The search/print process was repeated 17 times to produce the 17 sheets of A4, each featuring a different node word.

The idea for Paper World Room arose from my early work with the Bank of English, beginning in 1984 with the first Collins Cobuild English Language Dictionary. At that time the Bank of English consisted of around 6m words rather than the current 400m, and individual computer terminals were not available. Instead, each lexicographer was supplied with printed sheets showing every citation of the word to be investigated, arranged with the node word in a central column.

Reading through the citations for a particular word, lexicographers would colour in different senses or structures using felt-tip pens. This hand-coloured computer printout, a hybrid of illuminated manuscript and electronic database, was the evidence on which dictionary information was based and was also the starting point from which Paper World Room eventually developed.

Duncan Marshall

Duncan Marshall is a lexicographer and artist living in Glasgow. Most of his paid work is on dictionary projects for the publishers Harper Collins and involves the Bank of English, a 400m word corpus of text gathered from sources including books, newspapers, magazines and transcriptions of radio broadcasts and conversations. His interest in the relationship between information, consciousness, technology and the body have led him to use material from the Bank of English in a variety of novel ways, including installations for Glasgow School of Art and CIRCUS. His complementary preoccupation with form and pattern is explored in Analog Window, an ongoing project using nonphotographic 35mm slides, made by applying materials directly to prepared slide mounts for display in spaces such as clubs, restaurants and galleries

Pedro Rebelo, Franziska Schroeder – *"l a u t media-theatre"*

Performance for saxophone and electronics

l a u t media-theatre is an interactive multi- media performance with saxophonist Franziska Schroeder and composer/digital artist Pedro Rebelo. Since 1999, l a u t has been performing improvised and composed works for saxophones and electronics, including at Música Viva 2000 in Lisbon, World Art 2000 in Denmark, Sound Practice 2001 and Rotterdam Music Biennial 2001. l a u t has been developing a series of inter- faces which allow for the manipulation of elec- tronic and multimedia forms to become compara- ble to the richness of musical instrumental performance. works in the performance will include sub_friction [multimedia performance],"Aquas Liberas [mulitmedia piece], and improvisations with live-electronics taking the sound of the saxophone through a series of spectral manipu- lations.

Pedro Rebelo and Franziska Schroeder

Pedro Rebelo – Composer//Digital Artist
Born in 1972,Viseu –Portugal

Studied electroacoustic composition at UEA, Norwich (England) with Simon Waters at Masters level. Presently completing his PhD under the supervision of Nigel Osborne, Peter Nelson and Richard Coyne at Edinburgh University where he teaches music technology and coordinates multimedia projects in the Department of Architecture.

Pedro Rebelo's approach to music making is defined by the use of improvisation and interdisciplinary structures. He has been involved in several collaborative projects with visual artists and is currently explor-

ing the relationships between architecture and music in creating interactive performance and installation environments. His most recent compositional work comprises a series of commissioned pieces for soloists and live-electronics which take as a basis the interpretation of specific acoustic spaces. In the duo laut with saxophonist Franziska Schroeder he performs works for saxophone and digital media which deal with the extension of interfaces and control in interactive performance practices. His work is regularly performed and broadcast in international contexts. He is musical assistant for electroacoustic festival Música Viva since 1999 and has recently been appointed the contemporary music and multimedia editor for the artist-magazine Número.

Franziska Schroeder –Saxophonist
Born in 1972,Weimar –Germany

Franziska is dedicated to the development and performance of new and improvised saxophone repertoire, especially works incorporating live-electronics and multimedia. After studying the saxophone in Berlin for 5 years, Franziska moved to Australia, where she was awarded her Bachelor of Music Degree in 1998 from the Conservatorium of Music in Tasmania, with First class Honours and the University Medal. Franziska 's Honours thesis researched multiphonics for the alto saxophone. As part of this research project, she commissioned various Australian works for saxophone based on this technique.

Over the past twelve years Franziska has performed at festivals and concerts in various Australian and European cities. She has also recorded for German and Australian Radio.

Mika Ripatti: *"Terror "*

Film, approx 5 min

Media Lab, Helsinki. One of our teachers and a Graphic Design student Mika Ripatti presented his final thesis work, the 3D computer-animated short film "Terror", in the Graphic Design Department, December 1999. Terror is a short trip to the interaction between two different worlds, designed in the spirit of Tex Avery and screwball comedies. The film was produced in the Media Lab. Launch date: 13.12.1999

Alex Sanjurjo Rubio, Iéximal Jélimite: *"Ventilar"*

Performance

Ventilar is an attempt to explore the boundaries between contradiction and non-contradiction, high and low art, possibility and impossibility, credit and discredit, significance and non-significance, communication and non-communication, interaction and non-interaction. It consists of a set of 16 interactive screens without any direct link between them. The connections are the conceptions (and their respective contradictions) that grow up through the course of interaction. The set of screens questions the reception as contemplation, and also the reception as game. They are 16 screens whose sound is nor something anecdotal, neither spectacular, but it is understood as knowledge.

The performer of Ventilar can sometimes interact by using the keyboard and the arrow keys, sometimes by not using them, sometimes by pressing the right button of the mouse, and in some cases by pressing something at the right or at the wrong moment.

Ventilar has been presented during 2001 in the 2nd Sound and Visual Festival and Zeppelin Sound Art Festival in Barcelona, in the 9th WRO 01 International Media Art Biennale (Poland), where it was awarded with a special mention, in the FILE2001 Electronic Language International Festival (Brasil), and in the I3 Orbit Village (Switzerland).

Alex Sanjurjo Rubio and Léximal Jélimite

Alex Sanjurjo Rubio
http://www.iua.upf.es/~asanjurj

Alex Sanjurjo Rubio holds a Higher Degree in Fine Arts by the University of Barcelona, and a Master in Digital Arts by the Pompeu Fabra University. Besides his digital art creation activity he is the pedagogical coordinator of the UPF degree program “Tools and ideas for interaction in internet”, and he also teaches Arts in Primary and Secondary School.

Iéximal Jélimite
http://www.mp3.com/IJ

Iéximal Jélimite has been doing soundscapes since 1985. It has self-edited and self-produced several electronic music works, and recently has been sonifying experimental videos.

Stanza: *"Amorphoscapes" and "Central City"*

Net/WebArt
http://www.amorphoscapes.com

The new digital labyrinths by Stanza. Interactive audio visual digital paintings and drawings for the internet. Journeys and experiments in audio visual sensual pleasure. They are audio visual paintings, and can be installed into 'real' environments, were the movement of people in the room or gallery triggers the interactivity within the work. Interactive art on the interent. 3d and generative sounds. A whole series of works investigating replication, cellular forms , pictures that you can interact with and generating sounds. Amorphoscapes move away from 'linear' pieces into a more non linear and interactive experience giving the audience some control over the artwork. Amorphoscapes allows you to experience different artworks depending on how you choose to navigate. Evolving pieces exist, that the "user" has to control of and makes them work by movement.

As reviewed on ITV in the web review and featured on sonic artsnet for the gallery channel. Also shown on the deigners network. An environment with sounds that can be selected that allow images to be altered. Cellular automata. The cells generate and move when the user makes them.

Central City" gives the audience some control over the artwork. The user can choose what they experience. There are now over 30 areas of the Central City, and each area has lots of things within each section so chances are you won't find everything. (IN TOTAL OVER 200 MOVIES some movies can only be found by clicking through areas) These areas are:- universa constructor videotron megalopotron univercity smallworlds textourama elevator maputor proser city central citoxity fostexity textus sounder randomizer cuboid matrixity advercity fibrinet.

Stanza

http:// www.stanza.co.uk

Stanza works in internet art, multimedia, electronic music and painting. Projects include subvergence which subverts and fragments the notion of our old browser. Instead we have full screen desktop takeover. Transportron which includes generative audio and image environments built into three d spaces and user controlled three d spaces. The Central City is an audio visual, interactive, internet art, experience all made for the internet. The city becomes an organic networks of grids and diagrams, juxtaposing urban sounds and sights. A number of these interactive online net artworks have been exhibited internationally and have won net art specific awards, including cynet art 2000 in Germany.

Todor Todoroff: *"Voices Part I" and "Voices Part II"*

Tape,
"Voices Part I" (1997, 5'11) and
"Voices Part II" (1999, 11'43)

VOICES (1997-1999)

These are the two first movements of an on-going project, exploring different ways of using voices. Each movement may also be played independently. The first movement was originally composed as quadraphonic piece, the second as an octophonic one. This CD is a stereo reduction that doesn't allow the full spatial organisation of sounds to come forward. The ADAT version should be preferred for concert.

VOICES Part I - Ouverture (May 1997) 5'11

Everything started when I was experimenting with instruments combining delay lines, filters and modulators on a MARS (Musical Audio Research Station) while preparing an interactive installation project back in 1996. While I was transforming voices and percussive sounds, using those real-time instruments, some textures started a life of their own and wouldn't fit within the initial project. Since then I knew I would one day let them express their very nature in another context.

"Voices Part I" Explores the poetry of those sound materials and combines them with some sounds generated through granular synthesis. It plays with the contrast of both rhythmical elements and steady ones, appearing to be suspended in time. With all my thanks to La Selva, Principe Antonello Ruffo di Calabria and Sylviane Sapir who allowed me to play for a long time with the MARS... as well as to Birgitte Odgaard Nielsen for letting me play with her voice.

"Voices Part I" was composed at studio ARTeM (Art, Recherche, Technologie et Musique, Brussels) and was premiered on May the 30th 1997 at the International Bourges Festival "Synthèse 97".

VOICES Part II - Distant Voices (October 1999) 11'43

"Distant Voices" is a very personal piece. I sometimes think that the reason I decided to compose electroacoustic music has a lot to do with an often repeated child experience. About the age of seven I started making small radios with a handful of components. Those radios had no amplifier and could only be listened to with a small crystal earphone. I spent hours listening to many different short-wave radio programs before falling asleep. As the tuning was far from perfect I usually picked up two or three programs at the same time, focusing on one or the other, most often foreign languages I didn't understand.

I was fascinated by those mysterious voices, and by the coincidences that arose from time to time between different programs, like if they were talking to each other even though they were probably thousands of miles away from each other and speaking different languages. I wanted to recreate an imaginary world of sounds reminiscent of the feelings of endless spaces and weightlessness I experienced then. I included telephone voices as a metaphor of this paradoxical situation of being both very close and absent. I constructed an octophonic space where different voices are like islands of flickering light in a night full of beeps and long high-pitched frequency sweeps.

"Voices Part II - Distant Voices" was commissioned by IMEB (Institut de Musique Electroacoustique de Bourges) and was premiered at the International Festival "Synthèse/00" in Bourges on the 13th of June 2000.

Todor Todoroff

Born in 1963, Telecomunication Engineer, First Prize and "Diplôme Supérieur" in Electroacoustic Composition at the Royal Conservatories of Brussels and Mons. He was for 5 years head of the Computer Music Research at the Polytechnic Faculty in Mons (Belgium). He is co-founder and president of ARTeM (Art, Research, Technology & Music) and FeBeME (Belgian Federation for Electroacoustic Music), administrator of NICE, member of the Bureau of ICEM and Belgian representative of the European COST-G6 Action "Digital Audio effects".

Showing a special interest for sound spatialisation and for research into new forms of sound transformation, he composes electroacoustic music for concert, film, video, dance, theatre, and sound installation. Prize of the Audience at the International Noroit Competition (France, 91), finalist at the International Luigi Russolo Competition (Italy, 92), the I. Concorso Internacional de Musica Eletroacustica de Sao Paulo (Brazil, 95) and Musica Nova (Czekia, 2000).

Sam Woolf: *"The Sound Gallery"*

Installation

"The Sound Gallery" is an ongoing experiment in art and science that grew out of research in the field of Evolutionary Electronics at the University of Sussex, England.

The aim of this experiment is to utilise ideas and techniques derived from the science of Artificial Life to create an interactive and adaptive installation artwork that displays aesthetically interesting behaviour. This paper gives a brief overview of the 'sound gallery' project, and discusses some of the recent developments that have been made. Recent work on the ‘sound gallery’ project has mainly involved the development of ultrasonic range-finder devices for use as a portable sensory apparatus and novel interface to the sound gallery system.

The field of Artificial Life is one that has been explored by a number of recent artists. It has spawned a diversity of new media, and has proven a rich source of inspirations. There now exists a substantial body of work belonging to the canon of A-life art, and a growing number of artist/scientists who are increasingly active in the field. "The Sound Gallery" adds a new artwork to this lineage, drawing inspiration from other works of A-Life art, but also making some notable advances. It achieves interactive and adaptive behaviour in novel ways, making use of reconfigurable hardware technology that (as far as we are aware) has not before been appropriated for artistic ends.

Sam Woolf

Sam Woolf is a Phd candidate at the University of Sussex, Brighton. He researches and develops interactive and automomous artworks. His background is in digital film, artificial life and philosophy.

Jody Zellen: *"Ghost City"*

Web/Net Art

GHOST CITY is a website that focuses on the representation of the city by the mass media. It uses the space of the web as a sculptural space, allowing viewers to interact with animated graphics to delve deeper and deeper into an imaginary city. GHOST CITY is a labyrinthine environment through which viewers can navigate, either following the linear narrative that unfolds by moving from page to page, or they can delve into the non-linear chaos of random links. Each space is made up of appropriated images and texts. The images are culled from various print media sources. The texts are either found passages from urban theory or specifically written poetic musings on the city. Rather than present static images, GHOST CITY is a collage of moving parts. It is a pulsating grid of flashing images that loop indefinitely. The viewer is an urban wanderer moving through the site, step by step, page by page. One moves forward and back retracing ones steps within the urban grid, discovering new spaces and new meanings. GHOST CITY is about memory, and about traveling through time and space. The time is infinite. The space is finite. Yet the time and space of GHOST CITY metaphorically relate to the experience of the city where people walk and talk and interact. Within the confines of GHOST CITY visitors can pause and think and move backwards and forwards. GHOST CITY is a city of fragments. A memory. A ghost of reality. A ghost city.

Visual Chaos is a short web work that that explores the idea of chaos on the web. In Visual Chaos I created a number of moving windows, as well as windows that appeared in specific places on the screen. I wanted there to be a screen filled with little windows, all doing there own thing. I also used a clickable list to create a poem. Each word is a link that opens a new window. You can read the poem a number of ways. Contained within Visual Chaos are a number of flash movies that use historical images of Los Angeles as source material adding current images and texts as animations to explore the relationship between the past and the present, as well as the ancient, the modern and the future city. Visual Chaos uses the space of the web as a sculptural space, allowing viewers to interact with animated graphics to delve deeper and deeper into an imaginary city. The images are culled from various print media sources. The texts are either found passages from urban theory or specifically written poetic musings on the city. The site explores ideas relating to an abstracted idea of the city. The images depict shadows and bodies. It explores the ideas of being swallowed by the city. In Visual Chaos I explore grids as a metaphor for the many different paths one can journey down in the modern city. One of the things I am interested in is to counter the use of the web as a source for information

Jody Zellen

Jody Zellen lives in Los Angeles, California. She works in many media simultaneously making photographs, installations, net art, public art, as well as artists' book. The subject of her work is the city and how one can simulate the experience of being in a an urban environment. She has been making web sites since 1997 and is constantly updating her interactive project, Ghost City.

AUTHORS – ABSTRACTS AND BIOGRAPHIES

Nicholas J Bailey: "Why Free Software Happens: A Survey of Motivation in the Open Software Community"

Abstract:

This paper asks the question “What examples of achievement exist where synergy is an important factor, and what motivates the parties to work in this way?” The area of excellence examined is the Free Software movement. Its origins are examined, and examples of notable free software projects are given. Some common misrepresentations relating to this environment are addressed. Finally the types of software licence commonly used by the Open Source and Free Software communities are summarised.

Nicholas J Bailey

Nick Bailey graduated from the University of Durham in 1986 with a joint honours degree in Electronics and Computing. Having worked as a software engineer for British Telecom, he returned to Durham to read for a PhD in Music Technology which he completed in 1991.

Nick is currently the co-director of the Centre for Music Technology at The University of Glasgow, having moved from the Deputy Directorship of the Interdisciplinary Centre for Scientific Research in Music (ICSRiM) in Leeds in 2000. His current research and teaching interests mean that he works regularly with groups comprising musicians, engineers and computer scientists.

Oladele Bamgboye, David England, Yu Ming Tai: "*Unmasking 3 - A Framework for the Interactive African Art Museum*"

Abstract:

Unmasking 3 is a collaborative project that aims to put African Art on the Web. Artists and Computer Scientists are working together to put manipulable, 3D models on the Internet. The aim is not just to display the objects but also allow them to be manipulated by the viewers and allow the results of those manipulations to be shared. In this paper we describe the rationale for our work in returning collected art works to their former owners. We also describe the technical implementation of the manipulation and sharing process. Ultimately we aim to provide a framework through which museum objects can be shared with a new audience and take on a new life.

Oladele Bamgboye, David England, Yu Ming Tai

Oladélé Ajiboyé Bamgboyé

Oladélé Ajiboyé Bamgboyé is an artist born in 1963 in Odu-Eku, Nigeria, and based since 1996 in London, where he now lives and works. He received his MA in Media Fine Art Theory and Practice from Slade College of Fine Art in 1998. His current interests include the critique of the curatorial strategies of curating and promotion of "contemporary African art" and the critique of the quasi-anthropological approached in relation to globalisation and hybridity within contemporary inclusive post-colonial art exhibition.

http://www.bamgboye.f9.co.uk/CVoladele1.doc.htm

David England

Dr. David England is a Principal Lecturer in Computing Systems at Liverpool John Moores University. He gained his PhD from Lancaster University in 1991. He has worked previously at Glasgow University Computing Department and GMD, Sankt Augustin. His research interests include Human-Computer Interaction and Virtual Reality.

Yu-Ming Tai

Yu-Ming Tai is a MSc student at Liverpool John Moores University, he has worked in the field of CG, 3D Modeling , CAD, and related Web based Programming for last 8 years in Taiwan. His research Interests include Interactive Multimedia System, Internet working, and Virtual Reality.

Trevor Batten: "*Some Personal Remarks on the Creative Potential of Space (Towards*

***an Einsteinian Turing machine)*"**

Abstract:

The author believes that "art" should be an autonomous process which can participate in a dialogue with the artist, -that the computer is an ideal machine for realiz-ing this dialogue and that "conceptual space" provides not only the ideal set of techniques for its construction but is also the ideal environment for it to take place. This position is expanded by suggesting that our every-day understanding of space is in fact highly conceptual and probably not at all related to our actual experience of space. If we are prepared to accept that space is primarily a conceptual construct then we are able to enter the bizarre world which theoretical physics has success-fully exploited for many years now. We then discover that dimensions are not fixed, that space can be folded, cut and joined and playfully ma-nipulated in many ways -and that the way these games are played might be of vital importance because, even though the structure of space is fairly flexible, the struc-ture of the space also has significance. Not only can space represent a set of potential sensory images, a system for storage or retrieval of data and a physical or conceptual environment for us to explore - space can also be used to process space in many ways, often dependent on the spatial configuration of the ele-ments involved. However, even if one is not prepared to accept the more extreme claims of the author, then parametrical space may still prove useful in the construction and compar-ison of conceptual models -by forming a framework within which systems of representation can be devel-oped which could allow artists and others to present "subjective" ideas in a more formal way in order to en-courage exchange and discussion to take place within a nexus of conceptual and physical spaces in an open and yet "objective" way.

Trevor Batten

Born 16.5.45 Hillingdon, England. Produced computer generated graphic image with the help of a friendly mathematician in 1967 while studying at Exeter College of Art. The lack of facilities in those early days lead to a multi-disciplinary approach via the Institute for Sonology, Utrecht (1972) which involved a search for visual applications of sonological (electronic- musicological) concepts. This approach lead to the "Cross Media Mapping" project, which eventually died through lack of external support.

In 1987 the purchase of an Amiga computer financed by half a Work-grant from the Dutch Ministry of Culture enabled an experimental begin to be made (as an independent artist) with the development of dy-namic autonomous audio-visual automata. This work is now being continued in the multi-platform language Java.

Part-time lecturer at art colleges in Brighton (3-d foundation studies, 1968), Sunderland (printmaking, 1970/71) and Enschede (media art 1988/99). Has participated in various international conferences, semi-nars and festivals for electronic art.

Carola Boehm: "*Between Technology and Creativity, Challenges and Opportunities for Music Technology in Higher Education*"

Abstract:

A presentation at Bath Spa College University in June 2001 gave me the occasion to rethink the existing Challenges and Opportunities of Music Technology within Higher Education today. To integrate an interdisciplinary field, such as Music Technology, into an academic discipline-segregated structure, such as that existing in our Universities, provides, in many ways, more challenges than opportunities: in research as well as teaching and administration. This report will present an overview of this situation, fed by my personal and professional experiences working with or in various academic institutions. Several working groups and workshops, such as the EC funded CIRCUS project (Content Integrated Research into Creative User Systems)1 , the invited EPSRC Music Technology workshop 2 as well as the invited EC "creativity and technology"3 , have addressed relating issues of teaching creative and music technology courses in HE, with the result of giving it an even broader perspective. Although this is within a European context, most issues are possibly restricted to the British continent. In this light, this report tries to provide a deeper understanding into the inherent problems and the immense potential in which this discipline is currently standing: a potential which many universities are managing to exploit to a great academic benefit. The report will cover an initial attempt of defining the area of "music technology" within a realistic academic context, and subsequently look at some challenges of teaching this discipline within HE institutions. The changing face of research funding opportunities are sketched and described, and a conclusion based on this discussion is given.

Carola Boehm

Carola Boehm holds degrees in Musicology, Computer Science (Johannes Gutenberg Universitaet Mainz, Germany) and Electrical Engineering (Technische Hochschule Darmstadt, Germany). Currently lec-

turer for Music Technology at the Department of Music and Co-director of the Centre of Music Technology, University of Glasgow, her research has concentrated on the issues related to the delivery, storage and representation of music and its related information over wide area networks. In recent years she worked on research involving music information retrieval, music data structures, digital libraries for performing arts, object-oriented technologies for music applications and standards (encoded music and MPEG7). Funding for her research in the past four years has been from a number of sources, amongst them SHEFC, German and Dutch national funding, EC, JISC, British Library (LIC) and JTAP/UCISA.

Maria Manuela Carlos: *"The ARTIC Project"*

Abstract:

This paper will briefly describe the ARTIC Project – a Lisbon based Centre for Media, Art + Design – which is under development at ETIC (a technical school for multimedia and a CITE member). It will describe ARTIC's objectives, main structures and give a special emphasis on the already programmed research activities.

Maria Manuela Carlos

Maria Manuela Carlos is Founding Director of the Escola Técnica de Imagem e Comunicação in Lisbon., a private sector college which since 1991 has offered professional related courses in Video/Television, Sound, Photography and Design. It is the only centre in Portugal for advanced study and research in interactive multimedia and computer animation integrating artistic creativity, content- generation, and exploratory use of new communications and information technologies.

With a High Degree in Theatre and Masters Degrees in Management and Image management, Manuela Carlos began her activity as an actress. Afterwards she co-operated with the Ministry of Culture in the area of Drama, having also been responsible for the launching of a NGO dedicated to Co-operation and Development in the area of Teaching and Professional Training.

After official and public recognition, ETIC began being accepted as a privileged partner for companies working within the area of Image and Communications. ARTIC is Manuela Carlos' new project aiming at the establishment of new paradigms of research and advanced study joining together technical expertise and artistic creativity.

Matthew Chalmers (only Friday/Saturday): "*Theory and Practive in the City Project*"

Abstract:

The City project focuses on a treatment of the city that deliberately blurs the boundaries between physical and digital media. We are combining mobile computers, hypermedia and virtual environments in one system, and allowing each person to interact with others even if they are using quite different media or combinations of media. We have found it useful to consider the many media technologies and spaces as one design medium, because each person' s experience depends on them all. People' s activity continually combines and cuts across different media, interweaving those media and building up the patterns of association and use that make meaning. How people act and work is determined by the full combination of media that they can use and have used, and hence a narrow focus on technological media as the paramount determinant of activity underrates the influence of other media. Recent technological developments, including the ones we ourselves are engaged in, heighten or highlight a phenomenon already familiar through analysis of the effect of older media such as written text, maps and cinema. Our system is both driven by our theoretical approach and driving the development of theory. This paper describes some of the theoretical issues and directions we are exploring and our ongoing system development. One of our long-term aims is consistency between theory and design practice as we work in multiple media, support synchronous and asynchronous communication, and balance subjective and objective interpretations.

Matthew Chalmers

gained his PhD on 3D graphics and multiprocessor systems at U. East Anglia. Following an internship at Xerox PARC, he spent four years at Xerox EuroPARC in Cambridge working on computer supported collaborative work, ubiquitous computing and information visualisation. He started the visualisation group at Ubilab, Union Bank of Switzerland' s research lab in Zurich, working there for over three years. In 1999, after a research fellowship at U. Hokkaido, Japan, he joined Glasgow University. He is now a Reader in Computing Science and a principal investigator in Equator, an EPSRC Interdisciplinary Research Collaboration.

His current research focuses on social issues and design in ubiquitous computing, visualisation and collaborative filtering, and, more theoretically, relating linguistics and philosophy to information representation.

He has reviewed for a number of journals and events including ACM SIGGRAPH, IEEE Visualisation, IEEE Information Visualisation, the ACM Information Retrieval conference (SIGIR) and the ACM Conference on Computer Supported Collaborative Work, and is on the editorial board for Springer Verlag's Information Visualisation book series.

Interact Lab overview

The Interact Lab is a research centre concerned with possible interactions between people, technologies and representations. It is based in the interdisciplinary school of Cognitive and Computing Sciences (COGS) at the University of Sussex. It currently involves a mix of faculty, researchers and postgraduates from backgrounds in psychology, computer sciences, artificial intelligence, interaction design, hardware engineering and the arts. Its focus is on developing novel user experiences in a variety of settings, including the home, schools, public spaces and work. A major Interact goal is to create innovative experiences by embedding physical artefacts in the environment with intelligence. Another is to understand the socio-cognitive basis by which people interact with innovative media and environments

🗣 Pamela Cruise, Michel Binkhorst, Jurriaan Schalken, Igor Burstyn: "*Modeling synergy within research groups through metadata analysis of content objects*"

Abstract:

This paper proposes a model for the mining of content networks for the purpose of uncovering areas of potential synergy within research groups. This model is based on the assumption that there are a number of implicit factors shared among content objects that, though real, cannot be measured directly (latent variables). These latent variables reveal themselves in the various aspects of content objects that can be observed and documented (manifest variables). The application of this paradigm is an objective and democratic process rather than a hierarchical classification system. To illustrate the data analysis feature of the model's implementation, Principal Component Analysis was applied to the metadata associated with CIRCUS research papers. The proposed model is a potential answer to the challenge of applying architectures of information to the description of culture. It may lead to the development of a virtually self-sustaining system that will foster synergistic collaboration among research groups, allowing ongoing interpretation of the hidden inter-relationships between content objects.

Pamela Cruise, Pamela Cruise, Michel Binkhorst, Jurriaan Schalken and Igor Burstyn

Pamela Cruise

Cruise holds a bachelor's degree in English Literature from the University of British Columbia in Vancouver, Canada. Currently she is an M.A. candidate in the European Media Master of Arts program in Interactive Multimedia at the Faculty of Art, Media and Technology of the Utrecht School of the Arts. Her research interests include emergent culture and narrative spawning from information networks, online research environments, educational and cultural applications of interactive multimedia, and computer-mediated communication. Pamela's web content development clients have included the European Space Agency and the International Agency for Research on Cancer.

🗣 L. Diaz, M. Kaipainen: "*Designing vector-based ontologies: Can technology empower open interpretation of ancient artifacts?*"

Abstract:

Understanding ancient times through the interpretation of remains of artifacts and fragments of data is an archetypical example of the general cognitive task of making sense of multi-faceted meaningful information that allows a number of possible interpretations. Our goal is to reconsider this freedom that is conventionally only granted to experts, such as archaeologists and anthropologists, and propose an open interpretation perspective to knowledge design, empowering the layman to explore such data using their individual cognitive maps.

Lily Diaz and Mauri Kaipainen

Lily Diaz

Lily Díaz is an artist and designer working with technologically-derived artforms such as photography, video and digital media. Her interests focus on the areas of history, myth and representation. She has a Bachelor of Arts with honors in anthropology from Brandeis University. She has a Master of Fine Arts in

Computer Arts from the School of Visual Arts in New York City. Her final work for the M.F.A. degree was an essay, Pictorial Space in Computer Art, and a series of computer-generated stereographs.

During the years 1988-94, Díaz also worked as a freelance designer in New York City and participated in some of the first groundbreaking developments in the field of hypertext and multimedia development. Her clients included Fortune 500 corporations such as Down Jones, Intel and Merrill Lynch.

She has taught at the Pratt Institute of Design in Manhattan, the Universidad de Guadalajara in México, and has lectured in Finland, Norway, Puerto Rico, Spain and the United States. She is currently a researcher and is completing her dissertation at the Media Lab of the University of Art and Design Helsinki.

Mauri Kaipainen

Mauri Kaipainen works as a professor of applied cognitive and information processing science at the University of Art and Design Helsinki. He holds an MA in musicology and a PhD from the University of Helsinki from the intersection of cognitive musicology and cognitive science. His perspective to cognition features knowing-when, the scheduled (or rhythmical!) aspect of the embodied, situated and dynamic cognition. The methodological toolset of the author includes soft computing models of cognition. Currently Kaipainen's main interest is in applying such perspectives to the design of information management interfaces. He is managing the Soft Computing Interfaces Group at UIAH.

Pauline Donachy, Carola Boehm, Dr. Stephen Arnold, Karst deJong: "*MusicWeb Connect: A European Project for creating web-based Tools and Resources for Music Education*"

Abstract:

With the cornucopia of online education packages appearing on the web, Glasgow University in collaboration with the Royal Conservatory of Den Haag is again at the forefront of a collaborative project to create and to facilitate the production of music education resources. As with Netmuse, which was a previous collaborative project of Scottish music departments utilizing high performance networks (ATM) and creating university level musical educational resources, the Centre for Music Technology is co-ordinating the technical side of another internet / intranet-based project, MusicWeb Connect, in collaboration with five other European institution.

Pauline Donachy, Carola Boehm, Dr. Stephen Arnold, Karst deJong

Authors are part of the MusicWeb Consortium

The founding members of MusicWeb and MusicWeb CONNECT come from various areas of expertise and skills in the European music education world. Four music education and two technical institutions have joined forces in the MusicWeb CONNECT project in order to fulfill the idea of making web-based learning a primarily musical experience, and to support and enhance current European educational practices. The founding members of the MusicWeb CONNECT consortium are:

- The Royal Conservatory of Den Haag,
- The Centre for Music Technology, University of Glasgow
- The Hanover University for Music and Drama (Hochschule für Musik und Theater Hannover)
- The IRCAM Research Institute in Paris (Institut de Recherche et Coordination Acoustique / Musique)
- The IICM Institute in Graz (Institute for Information Processing and Computer Supported New Media)
- The Technical University of Darmstadt

MusicWeb is open to those who decide to join the MusicWeb group and use the music education resources and skills therein, or who want to use the authoring tools and facilities provided by MusicWeb to add to and enhance current materials with their own tools, specialist skills and music education modules.

The MusicWeb group has created the tools to enable anyone, as a member of MusicWeb, to access these weblications, and to facilitate the creation of new modules with maximum ease. There are no specialist skills or knowledge required to use or author weblications, although knowl-edge of the internet is needed, and some knowledge of HTML is helpful. For more advanced users, additional training can be provided where necessary.

MusicWeb encourages access for all, and facilitates pan-European communication between music education institutions, teachers, students and professionals wherever they are based in the world, helping to promote and create a positive relationship within the European music community.

Steve Everett: "*Logics of Value for digital Music*"

Abstract:

This paper will present and discuss a philosophic argument for examining the values used in the subject-object relationship of digital music exchange. Use value is what practical use the music has for the participant and is most often different for composers and audience. The symbolic value of a work involves its potential for representation of some quality beyond its structure or use-value. Sign-value (status) is what social identity audiences associate with a work, composer or genre. This is often a factor in determining who attends live performances or downloads audio files. Finally, exchange value or object as commodity is perhaps the most important for the majority of digital music consumed today. The requirement for reproduction, either through recorded hard media, in a concert setting, or over the internet poses interesting possibilities and challenges for the creator and audience of this music.

Silvia Gabrielli, Eric Harris, Yvonne Rogers, Mike Scaife, Hilary Smith: "*How Many Ways Can You Mix Colour? Young Children's Explorations of Mixed Reality Environments*"

Abstract:

How do we conceptualise and design mixed reality environments (MREs) to support creative play? Here we describe a first pass at a conceptual framework and use it do design a MRE for young children to explore in, focussing on the familiar activity of colour mixing. Different set-ups were provided, where paint or light colours could be mixed, using either physical tools, digital tools or a combination of these. The paper describes how children collaboratively discovered creative ways of using the mixed reality spaces for colour-mixing. We reflect on the success of the framework and our findings for designing effective play in MREs.

Silvia Gabrielli, Eric Harris, Yvonne Rogers, Mike Scaife, Hilary Smith

Silvia Gabrielli

Silvia Gabrielli is a post-doc researcher at the Interact Lab (COGS, Sussex University), during her PhD in cognitive sciences she has investigated the area of learning from a socio-cognitive perspective. She has previously worked on the design and evaluation of desktop virtual environments as new devices for supporting the development of spatial abilities in young children. She is now involved in the study of mixed reality environments as new experimental settings to enhance children's creativity during playing activities.

Eric Harris

is a Research Fellow at the Interact Lab involved in the design and prototyping of interactive digital toys and mixed-reality environments.

He has worked for a number of years within the robotics industry, most recently developing hexapod technology. He has particular experience in the integration of vision systems within multi-sensor autonomous environments.

Yvonne Rogers

Yvonne Rogers is currently co-director of the Interact Lab and a reader in cognitive science. She is interested in how people interact with external representations – be they diagram, sketches, animations, multimedia, virtual environments or other. Her research is concerned with developing a theoretical account of the external cognition that occurs when people create, manipulate and read different representations for various kinds of activities. She is also interested in how novel technologies and new media can be designed and developed to support innovative forms of playing, learning and working.

Mike Scaife

Mike Scaife is a reader in Psychology and co-director of the Interact Lab. He has a background in developmental-cognitive psychology and is applying this to the development of a theory of external cognition. The aim of this is to understand how external representations, whose form can range from paper-based diagrams to multimedia and virtual reality environments, can support cognitive processes as diverse as problem-solving, learning, play and creativity. The theory is used to design applications using new media to produce innovative visualisations and interactivity for school/workplace/home.

Hilary Smith

Hilary Smith is Research Fellow at the Interact Lab, she is interested in how people interact with IT, how it enables them to perform everyday tasks and the environmental and social contexts within which peo-

ple use IT. She has worked on IT consultancy, on software design and development for systems used by defence, energy and transport customers. Other work areas include flight simulation and working with non-verbal children on a system that used their existing pictorial code to access stored speech output via a synthesiser.

David Garcia: *"The Joy of Lists"*

Abstract:

The American theorist Peter Lanbourn Wilson made a useful distinction between what he called 'intimate media' and 'mass-media'. He spoke affectionately of pirate radio and of the zine or the small-scale publication as creating an intimate relationship with its audience, intimate media invites discourse. He contrasted this with speaking or writing through the mass-media which, for Bey, these forms creates no resonance, 'no returning echo'. As the on-line mailing list invites discourse at first it seemed to exemplify 'intimate media' but there is more to it than that. If I e-mail one of the subscriber authors personally or one of the documents contain references and links to large public websites I can find myself sliding between intimacy of a personal correspondence and a mass communications domain. A powerful list is neither exclusively a mass or intimate media but something else a meta medium. A strange new social process giving rise to new content

David Garcia

David Garcia is Professor of Design for Digital Cultures at Portsmouth Universtity and Courseleader for Interaction Design Masters program at Hogeschool voor de Kunsten te Utrecht (department of Art, Media and Technology). He is also co-ordinator of the EU-project CIRCUS (Content Integrated Research into Creative User Systems, http://www.circusweb.org).

Artist and media arts producer exhibiting at prominent international venues. Initiator and established convenor of an important series of new media network events, e.g. The Next Five Minutes series of conferences on tactical Media www.n5m.org and most recently October 2000 Net.congestion (International Festival of Streaming Media) .

Collaborator with Society of Old and New Media on projects such as the International Browser day. The important innovation with all the events mentioned above is the use of a combination of electronic communications media such as television, radio and computer networks to enhance live events and public debate.

He also works in galleries and museums to explore in more subjective ways the ideas generated by the large scale public events. Recent exhibitions and presentations include: (1995) Stedelijk Museum Bureau Amsterdam, Netherlands. (1996) Presentation of large scale video installation at Institute of Contemporary Arts, Antwerp, Belgium. (1997) Screenings and Lecture with Hybrid Workspace in Dokumenta Halle, Dokumenta, Kassel, Germany. (1998) Screening at ICA London (1998) Screening at ISEA, Manchester. (1999) Paintings exhibited in Gallery Aschenbach.

(2000) Screening and presentation at Soros Foundation, Bucharest, Romania, Timing Art, Forming Art. (2000) Installation at Art Kitchen (Amsterdam Gallery). (2000) Installation at Gallery Outline. He is a frequent invited speaker at research events.

Greta Mary Hair, John Gormley: "*Aquitanian Chant Notation: a Web-Based Tutor*"

Abstract:

The chant notation tutor to be demonstrated in this session has enabled the study of early chant notations to enter the undergraduate curriculum. This tutor is not only the first to appear in an electronic medium, but it is also the first to appear in the English language.

John Gormley and Greta-Mary hair

John Gormley

John Gormley was born in Glasgow and studied at the University of Glasgow where he was Organ Student from 1993-1995 and Organ Scholar from 1995-1997. After graduating with an M.A. in Music, he went on to take the M.Mus in Composition and an M.Sc. in Information technology. It was during this period that he directed the University Chamber Singers. From 1995-1997 he also directed the octet Song-Circle. Since October 1998 he has been a part-time tutor and lecturer in the University of Glasgow department of Music and organist of Sherbrooke-St. Gilbert's Parish Church. In October 2000 he was appointed Assistant Organist at St. Mary's Cathedral in Glasgow. Since August 1999 he has directed the Eastwood Choral Society. From September 2001 he will take up a position as tutor of Theory and Musicianship at the Junior Academy

of the RSAMD. As a composer, John has had his music performed by Cappella Nova, Scottish Voices, the University of Glasgow Chapel Choir and the choir of St. Mary's Cathedral.

Greta-Mary Hair

Greta-Mary Hair is an honorary research fellow and occasional lecturer in the Music Department of The University of Glasgow. She lectures on 11th-century Aquitanian chant notation and is currently preparing an edition of the Office of St Kentigern (or Mungo), patron saint of Glasgow, in collaboration with Betty Knott-Sharpe for the Musica Scotica series. Editorial problems concerning the reconstruction of 11th-century troped chants was the subject of her PhD thesis and she is working on an edition of this material for publication in the Corpus Troporum series. Greta-Mary has held lecturing positions at the Riverina College of Advanced Education and at Latrobe University. Together with Robyn Smith, she edited the volume of articles entitled Songs of the Dove and the Nightingale, she has published a number of articles and read numerous research papers in Australia, the UK, Europe and the USA.

D.R.Lawrence, A. Gracie: "*Streaming sensor driven Midi - triggering remote interactivity*"

Abstract:

In recent years there has been a rapid upsurge in the use of digital audio in art installations and web-based events. There has been a development from the simple use of sequencer hardware and digital audio files, to relatively complex implementations involving the use of multimedia, interactivity, sensors, and webcasting. One aspect that has tended not to be explored is the streaming of 'live' midi data over the Internet, and its role in interactive composition.

This paper is based on in-depth personal experiences in this field, and discusses issues and findings important to advancing the use of this leading edge technology in an arts and interactive context. The installation work discussed involves the use of the I-Cube sensor interface system, midi data generation, and 'live' Internet streaming of midi data. In particular, the solar eclipse 'Totality G2V 2:23' event (http://www.agraphic.co.uk/ eclipse.htm) on August 11 th 1999 is discussed. The paper is likely to be of interest to digital audio artists, sonic art musicians/composers, researchers into innovative creativity, webcasters, arts event/installation organisers, multimedia artists, and multimedia web designers.

Malcolm Le Grice: "*Virtual Reality - tautological oxymoron -*"

Malcolm Le Grice

Born 15 May 1940. Studied painting at the Slade until 1964. In 1967 had first exhibitions as a film and video artist and started a film department at St Martin's School of Art. In 1968 helped established the London Filmmakers Co-operative workshop. In 1969 had first exhibition of a computer work and first European film tour. Published theoretical/critical essays regularly from 1972 and 'Abstract Film and Beyond' (Studio Vista) in 1977. Continues to publish regularly on experimental film and digital arts. Frequent international tours, exhibitions and festival screenings since 1970 including shows at the Museum of Modern Art, New York, the Louvre, Paris, the German Filmmuseum, Frankfurt, The Art Gallery of Ontario, Toronto and film retrospectives at the ICA London and the Cinematheque Valencia. Televison screenings include Finnegans Chin (1983), Sketches for a Sensual Philosophy (1990) and Chronos Fragmented (1995).

Duncan Marshall: "*'The English Earbook' and Creative Linguistics*"

Abstract:

The English Earbook is a proposed atlas of our soundworld and the words we use to map it. Based on my work as a lexicographer and information mainly from electronic reference sources, most notably the Collins Bank of English, the project aims to chart the territory occupied in English by the language of sound and hearing. This is a work in progress, and any presentation given will consist of my findings to date and some of the issues these raise with regard to the perceived relationship between language, consciousness, culture and technology.

Duncan Marshall

Duncan Marshall is a lexicographer and artist living in Glasgow. Most of his paid work is on dictionary projects for the publishers Harper Collins and involves the Bank of English, a 400m word corpus of text gathered from sources including books, newspapers, magazines and transcriptions of radio broadcasts and

conversations. His interest in the relationship between information, consciousness, technology and the body have led him to use material from the Bank of English in a variety of novel ways, including installations for Glasgow School of Art and CIRCUS. His complementary preoccupation with form and pattern is explored in Analog Window, an ongoing project using nonphotographic 35mm slides, made by applying materials d-rectly to prepared slide mounts for display in spaces such as clubs, restaurants and galleries

🗣 Paul Modler, Tony Myatt: "*Video Based Gesture Recognition by Artificial Neural Networks for Interactive Music Systems*"

Abstract:

In recent years a vivid disscussion about processing of gestural data in musical applications came up. The discussion emerged from the background of interactive computer music systems and their use in performances, but also from the experiences of novell interfaces to control the generation of sound and musical processes. Due to the availability of a larger range of sensor systems and the increasing processing power, as well as novell software developments various combinations and paradigms of processing gestural data were established. They all use gestural data to control parameters of the composition or the artistic environment such as sound, light etc. Related to the discussion abaout processing of gestural data is the question of Mapping of control data onto musical parameters. Issues like the detection of higher level expressive information of music parameters are from great interest For different applications and goals a range of sensors and processing algorithms are available, each with specific advantages and drawbacks. Especially in dance or installation environments video systems are often used to track movements or objects of interest.

In our paper we describe a videobased system we developed for the recognition of gestural data. It analyses bodymovements to extract high level information of the movements which then can be used as artistic material such as control of sound, musical processes, light etc.

Paul Modler and Tony Myatt

Paul Modler

Paul Modler studied engineering in Karlsruhe, where he received the degree of a Diplom Ingenieur in 1987. Since then he is working in the area of computer applications in music. He puplished several papers for international conferences about interactive computer music systems and he contributed to journals and books. He worked for the Technical University of Berlin, the Federal Institute of Music Research in Berlin and Department of Music of the University of York as a researcher. He worked also as a freelance teacher for operating systems, programming languages and CAD. He published electro-acoustic compositions and is an active musician. Currently he is working at the University of Media and Design in Karlsruhe where he is leading the electronic studio.

🗣 Kia Ng , David Cooper and Bee Ong: "*Towards an Integrated Handwritten Music, Manuscript Analysis and Recognition System*"

Abstract:

This paper presents an ongoing research project on handwritten music manuscript analysis and describes a framework design for an integrated system which brings together a convenient music input interface using optical scanning technology and a graphical-user-interface for facilitating editing of the OMR (Optical Music Recognition) output that takes account of musical syntax, conventions and patterns. A brief background of OMR is presented, together with a discussion of some of the main obstacles in this domain. General low-level pre-processing modules for both printed and handwritten manuscripts are described, with illustrations, followed by a discussion of the development of a stroke-based segmentation approach using mathematical morphology. High-level domain knowledge enhancements and a semi-intelligent user-interface are proposed, and output format and future directions are outlined.

Steven Abrams, Ralph Bellofatto, Robert Fuhrer, Daniel Oppenheim, James Wright Richard Boulanger, Neil Leonard, David Mash, Michael Rendish, Joe Smith: "*QSketcher: An Environment for Composing Music for Film*"

Abstract:

We describe QSketcher, a new environment for composing music for film. The main design focus is the support of the early stages of the creative workflow, from idea conception through realization, rather than the mere order and synchronization of musical fragments with film. This paper describes the design process and rationale, the system, the user environment, and how they relate to one another. Novel aspects of the system include a free-form 'idea space', a main workspace that can be configured to individual needs, an "idea capturing" facility, a workflow tracking mechanism through which previous workspace states can be examined and restored, and the ability to create a variety of relationships among musical elements.

Garth Paine: "*Interactive sound works in public exhibition spaces, an artist's perspective*"

Abstract:

This paper explores the research and responsive environment installation works developed over the last five years by the Australian composer/installation artists Garth Paine . It addresses the area of responsive environments within the scope of an artist interested in using interactive sound to encourage a consideration of our relationship to our environment. The issue of public interpretation of the artworks is discussed, and in so doing the idea of a performance practice for interactive sound works is explored.

Garth Paine

http://www.activatedspace.com.au

Garth Paine is a freelance composer, sound designer and installation artist. He has been commissioned extensively in Australia the United Kingdom and Germany, producing original compositions and sound designs for over 30 film, theatre, dance and installation works in the last ten years.

In 1999 Garth Paine was composer in residence at the Staatliches Institut für Musikforschung (State Institute for Music Research - SIM) in Berlin, exhibiting his installation MAP1 in the Musical Instrument museum, Berlin during the residency. He was commissioned by SIM to produce MAP2, which was exhibited at the Museum for Musical Instruments, Berlin from December 30, 1999 to January 8, 2000. His installation work REEDS was presented by the Melbourne International Festival, 2000.

His most recent works include the score for the Company B production of the Laramie Project, directed by Kate Gaul, which opened in Sydney in March, 2001, and the Company in Space's Incarnate, a telepresence performance between Melbourne and HongKong in March 2001. He has been commissioned by the Melbourne International Festival to write a work for the Field of Bells which will be launched at the 2001 festival.

He has also exhibited responsive environment installations in 2001 in Melbourne, Sydney, and Hobart, and at the Australasian Computer Music Conference. Garth was awarded the RMIT, New Media Arts fellowship by the Australia Council for the Arts for 2000. In recent years Garth's work has become increasingly involved with the design of sound and interactive exhibitions in museums and galleries. These include the Melbourne Exhibition, the East Supper Space and the Immigration Museum for the Museum of Victoria, the Australian Jewish Museum, the Performing Arts Museum, and the Eureka Stockade Centre.

His formal training includes a Bachelor of Music (Performance) from the Tasmanian Conservatorium of Music, and a two year Sound Engineering Trainee-ship with the Australian Broadcasting Corporation. He has been Lecturer in Electronic Music at the Conservatorium of Tasmania and RMIT, Melbourne, and will lecture this year at the University of Melbourne, and the Victorian College of the Arts, Melbourne.

John Patterson: "*Using the Web as a Pedagogical Tool*"

Abstract:

This paper summarises the case for one particular model of teaching reinforcement, a process considered normal in US Universities but largely left to students in the UK system. The first argument presented is that the student cohort now going through the UK system is more like a traditional US mix than a traditional UK mix yet UK Universities have not woken up to this. The second argument presented is that if teaching reinforcement is mediated by electronic means, e.g. via the Web, then this represents a

commoditisation of knowledge and de facto creates a market in which such commodities are traded. The third argument is that the convenience of commoditised knowledge will create its own demand, particularly in the present state of the market, and enforce the economics of 'the best drives out the rest' in a very similar way that happens in film and does not in the theatre. The size of the market and 'best drives out the rest' economics will cause a damaging polarisation of scholarship if thought isn't put in at the beginning as to how to avoid this. It is argued that existing attempts at doing this will prove ineffective but potentially effective solutions have not yet been attempted.

This all assumes that such a commoditisation is feasible, something which is increasingly doubted by commentators. The argument given here is that it is feasible and the technical and presentational issues surrounding it are elaborated. We then show that there are no exemplars of the approach(es) we are advocating. Instead, a number of research issues involving technology, pedagogy and production values are identified as requiring answers before the feasibility issue can be resolved either way. We believe feasibility will be established but we need exemplars to prove the point.

Not discussed here are the economic or business case for such a commodity market. This is discussed in other papers[Pat99] [Pat01.2]. On the back of feasibility comes inevitability but this will be served neither by the rush to implementation in the present state of ignorance, nor by dangerous denials of the reality of the problem, for which the UK is uniquely-ill equipped to face up to.

John Patterson

Dr John Patterson is a Senior Lecturer in Computing Science at Glasgow University and Research Director of the Glasgow 3D-MATIC Laboratory in the recently re-formed 'Imaging' Faraday partnership. He specialises in research in cartoon animation and the extension of cartoon technology to image manipulation and film effects technology generally. He was project coordinator 1994-6 for the ANIMAX project which was the winner of the MEDIA Investment Club funded Computer CARTOON competition to develop software for the European animation industry. He is Principal Investigator for the EPSRC-funded research projects 'Models from Movies', and 'Shrink to Fit' and has been (Glasgow) PI on some 12 other projects including PAVR (European TMR Network of Excellence in Computer Animation) and CIRCUS (ESPRIT Working Group on Media Content Research) and three wholly commercial projects. He is a member of the BCS and an associate member of the IEEE and the BKSTS (Moving Image Society).

Tim Putnam: *"Capability and Competitiveness in the New Creative Industries Education, Training and Competitiveness in New Creative Enterprise"*

Abstract:

The purpose of this paper is to examine the contribution made by education and training to competitiveness in new creative enterprise, that is, recent business initiatives involving the creative application of information

technologies in cultural content. generation and communication. Surveys of perceived enterprise needs and of the early career patterns of graduates are examined to identify the content and pedagogic structures most relevant to forming individual capability relevant to the new creative industries. The paper highlights the importance of integrative multi-skilled project-based learning to success in this rapidly changing sector.Aukje Thomassen; Emile Bijk

Pedro Rebelo: "*On the Coherence of Sonic Space*"

Abstract:

Sound,as a physical phenomenon is dependent on space for its articulation.This paper attempts to define a number of issues concerning the creative use of sound in relation to space.Recent technological developments stimulate an integration of a number of conditions previously confined to disciplines such as music,architecture,or sculpture. The author 's creative work in nstallation art and composition is used as a platform for examining structures which are able to provide modes of interaction between sonic worlds,physical and virtual space.The use of acoustic measure- ments of spaces has become central in the author 's compositional processes.Inter-media coherence is examined as drawn from spatial perception in physical and virtual worlds;the architectural and acoustic experiences of moving through space are described as complementary attributes.

Pedro Rebelo

Born in 1972, Viseu – Portugal, studied electroacoustic composition at UEA, Norwich (England) with Simon Waters at Masters level. Presently completing his PhD under the supervision of Nigel Osborne, Peter Nelson and Richard Coyne at Edinburgh University where he teaches music technology and coordinates multimedia projects in the Department of Architecture.

Pedro Rebelo's approach to music making is defined by the use of improvisation and interdisciplinary structures. He has been involved in several collaborative projects with visual artists and is currently exploring the relationships between architecture and music in creating interactive performance and installation environments. His most recent compositional work comprises a series of commissioned pieces for soloists and live-electronics which take as a basis the interpretation of specific acoustic spaces. In the duo laut with saxophonist Franziska Schroeder he performs works for saxophone and digital media which deal with the extension of interfaces and control in interactive performance practices. His work is regularly performed and broadcast in international contexts. He is musical assistant for electroacoustic festival Música Viva since 1999 and has recently been appointed the contemporary music and multimedia editor for the artist-magazine Número.

Martin Rieser: "*The Poetics of Interactivity: The Uncertainty Principle*"

Abstract:

The discovery of ambiguity in the sub-atomic world was the essential catalyst for the twentieth century's abandonment of hierarchical Newtonian science; with its omniscient privileging of the observer.1 Quantum mechanics, revealed through Heisenberg's Uncertainty Principle, provided definitive proof of the ultimately unknowable and unpredictable nature of the universe-all versions of reality were thereafter tied to the subjectivity of observation. As the ambiguity of fundamental particles raised a conundrum for particle physicists, so for artists, writers, and filmmakers (engaged in the experimental discovery of appropriate form and language for interactive story and drama), the rediscovery of ambiguity in the language and structure of narrative still poses a primary challenge. However. it is the omniscient privileging of the author, as opposed to audience, which is now under contention. In this chapter, I hope to demonstrate some of the means by which interactivity and narrative can utilise the interpenetrative power of language to collapse the distance between subject and object, and between interior and exterior spaces.

Aukje Thomassen; Emile Bijk: "*Knowledge Management in Design Education*"

Abstract:

Since the early eighties, knowledge management has become a hot issue. Business researchers, consultants and media pundits from all over the world have exhorted today's companies to consider knowledge as an important aspect of production and a source of competitive advantage. Toffler (1981) and Drucker (1993) have described the transformation of western society from post industrial production (labour, capital and raw materials) to a society where knowledge is the predominant aspect of production and economic growth.

Trends in economic globalisation have led to ever increasing competition and shortening of life cycles of products and services. According to Porter and others, only organisations which are focussed on ever increasing added value will survive competition. According to Reich (1989) the recipe for survival in the post-industrial information society is the creation of organisations which value learning, creativity and the ability to innovate.

Aukje Thomassen; Emile Bijk

Aukje Thomassen

Aukje Thomassen MA, is currently PhD student at the Hogeschool voor de Kunsten Utrecht (department of Art, Media and Technology) in the Netherlands. As a research junior she's involved in the LEDA project [Learning Environments for the Digital Academy: http://www.ledanet.org], which evolves parallel to her own PhD thesis; a study into the interface design heuristics that engender a continuum of flow between individual and complex online application.

Before this she was working as an Application Artist at Telematica Institute [http://www.telin.nl]; developing demos and prototypes for future applications; content engineering, CSCW, in collaboration with scientists and engineers. During her studies she was already involved in research and development; she did an internship at Hewlett Packard Media Laboratory in Bristol UK as an interaction technologist on research and development for Digital City Bristol, among other things. Her research and development also extended to-

wards the field of interactive cinema and interactive installation; she made a demo for the Rotterdam Film Festival [1997], co-created “Keewa”; an interactive film [1998] about a looping event with multi linear story lines.

Besides Research and Development she’s also involved in VJ and DJ projects: Museumnacht 2001 [http://www.museumnacht.nl] as a DJ entertaining the visitors of the University Museum during the open museum night. Grote Oren, Grote Ogen, classical concerts performed by famous Dutch orchestras: the ‘Metropole’ orchestra, the ‘Radio Symphony’ orchestra and the ‘Radio Chamber’ orchestra. The classical concerts were supported by her visuals and her live VJ-ing: only for kids. U-treg Sound, a travelling circus through Holland with artists from various disciplines from the city of Utrecht. She created the video installation as well as VJ-ing live.

Emile Bijk

Drs. Emile Bijk studied Communication Science at the University of Nijmegen till 1995. After graduating he joined the Utrecht School of the Arts, faculty of Art, Media and Technology in the Netherlands where he initiated the Centre for Information Technology and Education. This centre develops applications and services for the Utrecht School of the Arts. Besides his position as head of the Centre for Information Technology and Education he is also head of Library and Information Services and Projectleader of several ICT- and Information Processing projects. Besides managing several nationally funded projects, he also initiated and currently manages the LEDA project. LEDA is an international project funded under the fifth framework of the IST-program of the European Commission that develops learning environments for students to enhance learning experiences by promoting the articulation and exchange of knowledge between students.

Andrea Zapp: "*Digital Cinematics (the book)*"

Abstract:

The advent of new media presents a serious challenge to our understanding of visual representation, of narrative and indeed the whole art of the moving image. New narrative forms in hypertext, multimedia, computer games, interactive broadcast and screen media are constantly redefining the relationship between the creators of content and their audiences, who increasingly are becoming the co-producers of meaning. These and the following issues of theory and practice are related to the forthcoming book and DVD publication: Martin Rieser, Andrea Zapp, editors: New Screen Media, Cinema/Art/Narrative, due to be published by The British Film Institute (BFI), London/Center for Art and Media (ZKM) Karlsruhe, in October 2001.

Interactive User Participation in Networked Digital Environments

The open structure of the Internet offers the most appropriate configuration to play with audience participation as an alternative form that could enrich our concept of media. I am trying to discuss and critically examine issues of interactivity and virtual forms of representation, of the body itself and parallel of new dramatic and narrative models. Interactive platforms based on a real time networked infrastructure can be designed as accessible environments for the viewer. Content systems can be set up that are actively shaped and further developed through the influence and contributions of participants from various remote locations. The general idea is therefore to constitute a seamless portal to the net itself as the main source material, making the borders between the individual and the theatrical room less obvious.

Andrea Zapp

http://www.azapp.de

Born in Germany, she is currently living in Manchester and works as artist-in-residence at the School of Art & Design, University of Salford. She received an MA in Film and Media Theory, Russian Language and Literature from the Philipps-University in Marburg in 1990. She has been teaching New Media Arts and Theory at the Academy of Film and Television in Potsdam-Babelsberg and at the Universities of Marburg and Leipzig, Germany. She was visiting lecturer at Arteleku San Sebastian, Spain and at the State University of Santiago de Chile. In 1997 she was an artist-in-residence at the Future Lab of the Ars Electronica Center in Linz, Austria, and in 2000 visiting artist at the Goethe Institutes in Latinamerica. She was nominated for the International Media Art Award 2000 and 2001 in Karlsruhe and received an Honorary Mention for Interactive Art at the Prix Ars Electronica 2000 and at the Art on the Net 2000 Competition, Machida City Museum of Graphic Arts, Tokyo. Her works have been shown widely on the net and in international exhibitions and conferences throughout Europe, USA and Japan.

CIRCUS 2001

New Synergies in Digital Creativity Conference for Content Integrated Research in Creative User Systems

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PAPERS

Why Free Software Happens: A Survey of Motivation in the Open Software Community.

Nicholas J Bailey*

October 9, 2001

Abstract

This paper asks the question "What examples of achievement exist where synergy is an important factor, and what motivates the parties to work in this way?" The area of excellence examined is the Free Software movement. Its origins are examined, and examples of notable free software projects are given. Some common misrepresentations relating to this environment are addressed. Finally the types of software licence commonly used by the Open Source and Free Software communities are summarised.

1 Reason for the Open-Source Synergy Theme

Effective dissemination of software and other technologies arising from the kind of projects which the Circus forum addresses is an important part of building an infrastructure upon which artistic and scientific synergies is built. The normal route for dissemination of materials arising from scientific and engineering endeavour is to attempt to market them. However, this may be an inappropriate course of action for the kind of deliverables likely to arise from the Circus-related projects:

- Commercialisation makes sense when the product is monolithic. If, as would probably be the case with Circus project results, the potential use requires not merely to reproduce results exactly but to extend, modify and contribute, the issue of rights ownership becomes unresolvable.
- Notwithstanding the above, it is possible that tools might be made available which artistic users might wish to use. In the event of commercialisation and closure of access to source codes, the copyright owner is essentially exercising an option to control the activities of the creator. Traditionally, the creator will accept these terms where s/he is unaware of alternative solutions, or no such solutions exist. This is contrary to proper dissemination of artistic works, and instead creates a dependency culture where users expect product support without synergistic input to its evolution.
- The only successful and proven method of permitting users free access to software is that adopted by the Free Software Foundation. The GPL (GNU Public Licence) requires that the source code be made available to all users on demand. It also places a strong copyright on the source code and thus protects the rights of the original authors and contributors while ensuring their work reaches the widest public without any marketing activity.

2 The Origins of the Free Software Movement

The cost of computing hardware used to be significant. Acquisition and maintenance of early mainframe computers was so expensive its cost dwarfed the expense of writing the rather limited software they were capable of running. Even when the complexity of software began to grow, software piracy was not a big issue: the party acquiring the software package would have to purchase a machine on which to run it, and the hardware vendors would recoup their costs.

This environment gave rise amongst software engineers and system administrators of the time to what is now often referred to rather disparagingly as the "Play Ethic". Code was frequently shared and solutions to common problems arrived at cooperatively and openly. Pat Kane's article Second Sight[1] which appeared in the Guardian newspaper on March 29th 2001 starts by citing the open-source community and concludes that the play ethic is responsible for much of the general success of the Finish society and economy.

As corporations began to tighten down on information about their products, citing the protection of intellectual property as their reason for doing so, coopera-

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[1] http://www.guardian.co.uk/Archive/Article/0,4273,4161088,00.html

tion between different groups of programmers became increasingly difficult. It became de rigeur to require non-disclosure agreements before any software source was exchanged, if indeed it was exchanged at all. A group activists formed themselves under the title of the Free Software Foundation.[2] The FSF works to abolish the closed mentality of commercial institutions by lobbying and by producing its own freely redistributable software.

It is because of the spirit of openness and cooperation between the different communities of users and programmers who make up the open-source movement that it is instructive for the CiRCUS member to be aware of their motivation and goals. Central to the play ethic and to much of the free software and open-source movements is the pursuit of excellence as an end in itself; a motivation surely more often associated in the popular mind with the arts rather than commercial enterprise. In fact, there is a range of motivations within the open-software community, and these are expressed in the various copyrights and licences which have arisen governing the use and distribution of "free" software.

Before examining them, we will survey some of the counter-attacks often launched at the open-source community which commerce and industry often regards as hostile. However, it is important before doing so to define what exactly is meant by "free" software. The FSF's Richard Stallman is at pains to distinguish "free" in the sense of "freedom" from "free" in the sense of "costing nothing". The FSF, he argues is about freedom, and but in fact encourages those adopting its principles to charge as much as they can for their work! His slogan "Free as in speech, rather than free as in beer" is a concise reminder of the difference.

Dr Stallman is also at pains to point out the difference between the free software movement and open source movement. Members of the free software movement believe in total freedom in the application and distribution of source code, and have generated strong legal frameworks to ensure that these freedoms are maintained. Members of the open-source movement believe that the open source idea is a good one because it yields robust and reusable code, but do not focus on the ethical and political issues of open software. Both, however, are members of the same open-software (or free-software) community.

3 Myths

3.1 Free Projects are Always Small Scale

Figure 1: Large-scale Free Software

The open-source community has developed systems which foster cooperative authorship and code maintenance. The machine on which this article was written runs Debian GNU/Linux[3] (Linux is the kernel; the rest of the packaged system is largely the work of the Free Software Foundation's GNU[4] project, although this is, unreasonably, rarely acknowledged) and has thousands of installed packages with a total of more than 105000 managed files.

The screen shots in Figure 1 show a session from Sun's StarOffice[5] package (overall screen-shot and detail) showing the word processor package flowing text around shaped images and a formula. Sun has recently placed the source code for the office package under the

[2] http://www.fsf.org/
[3] http://www.debian.org/
[4] http://www.gnu.org
[5] http://www.sun.com/staroffice/

FSF's licence. It continues to sell packaged versions of the software, and support.

This myth may have arisen because the activities of the free-software community are more often than not tool-based. It is considered more useful to write a collection of small programs with well-documented interfaces than to deliver a monolithic system. By exposing the interface at each level, the whole becomes more flexible and general.

3.2 Free Software is Unreliable

Examples of open-source software in high-reliability and critical applications:

- GNU/Linux is used on board the space shuttle;
- The apache web server is the most popular, robust and secure available;
- Almost all of the world's email is routed by `sendmail` or `exim`, both of which are free;
- TeX and LaTeX[6] are the most reliable document typesetting packages currently available: Knuth offers a prize for the discovery of a bug in the TeX code, and now only changed the version number by allowing it to approach π

```
nick@haydn:~> tex
This is TeX, Version 3.14159
(Web2C 7.3.1)
**
```

The image shows a screen-shot of the KDE's Konqueror web browser and file manager. Officially still under development, this browser has shown itself more stable than commercial software like Netscape's "Navigator". As of Version 6, Netscape has adopted an open-source policy for development. However, the open-source community has taken some time in adopting this project, and the current versions seem even less stable than the previous commercial product (version 4).

From the CiRCUS prospective, we observe how opening the user-base by encouraging the use of software through open-source methods encourages the community to test and improve the product. The benefits of the cooperative approach do not cease after a work has been made public, but continue as the product is used. By analogy, a freely accessible framework for the dissemination, use of, and participation in artistic works is equally as important as support for the generation of such works in the first place.

3.3 Open-source projects lack proper documentation and are unmaintainable

This myth arises from commercial sources which perceive a threat, real or otherwise, from the open-source community. Their assertion is that rigorous software engineering practice is not used outside of industry.

Experience denies this. Having worked in the software industry and supervised students placed in the in-house software divisions of some very large companies, I have yet to come across a single example of a commercial development which uses a rigorous code versioning system or formal documentation. Anecdotally, there seems to be two reasons for this: the management of software projects often have very limited experience in Computer Science, maybe coming instead from an Engineering or Physics background, and are ignorant of formal development methods; or code is developed by consultants who, in order to ensure future employment, keep supplied documentation to a minimum. There is some poetic justice in the fact that the protagonists of closed-source software are thus one of its first victims!

The image shows a detail from a screen-shot of a GUI CVS front end[7] designed to operate with the GNU CVS. GNU CVS is a full-featured code versioning system accommodating development branches and code roll-back. It is used at SourceForge[8] – a web-fronted repository for open-source projects run by VALinux inc.[9] For most large projects and many smaller ones, a rigorous to documentation and code versioning is a matter of pride to the developers.

From the CiRCUS prospective, we observe that the motivation to produce works of quality arises from the creator, not from a market-driven competition ethos. Many participators in open-source development regard competition as wasteful, because it implies duplication and that the majority of the work produced be discarded. There are no quality benefits in a market-based system unless the consumer is both fully aware of the requirements, and is competent to judge the products. In the case of artistic output, any innovative work must *ipso facto* be outside of the participants prior awareness, and in the case of closed, complex works or products, the consumer can neither be fully aware of its specification/inspiration nor expected immediately to understand it.

[6] http://www.ctan.org
[7] http://cervisia.sourceforge.net
[8] http://sourceforge.net/
[9] http://www.valinux.com

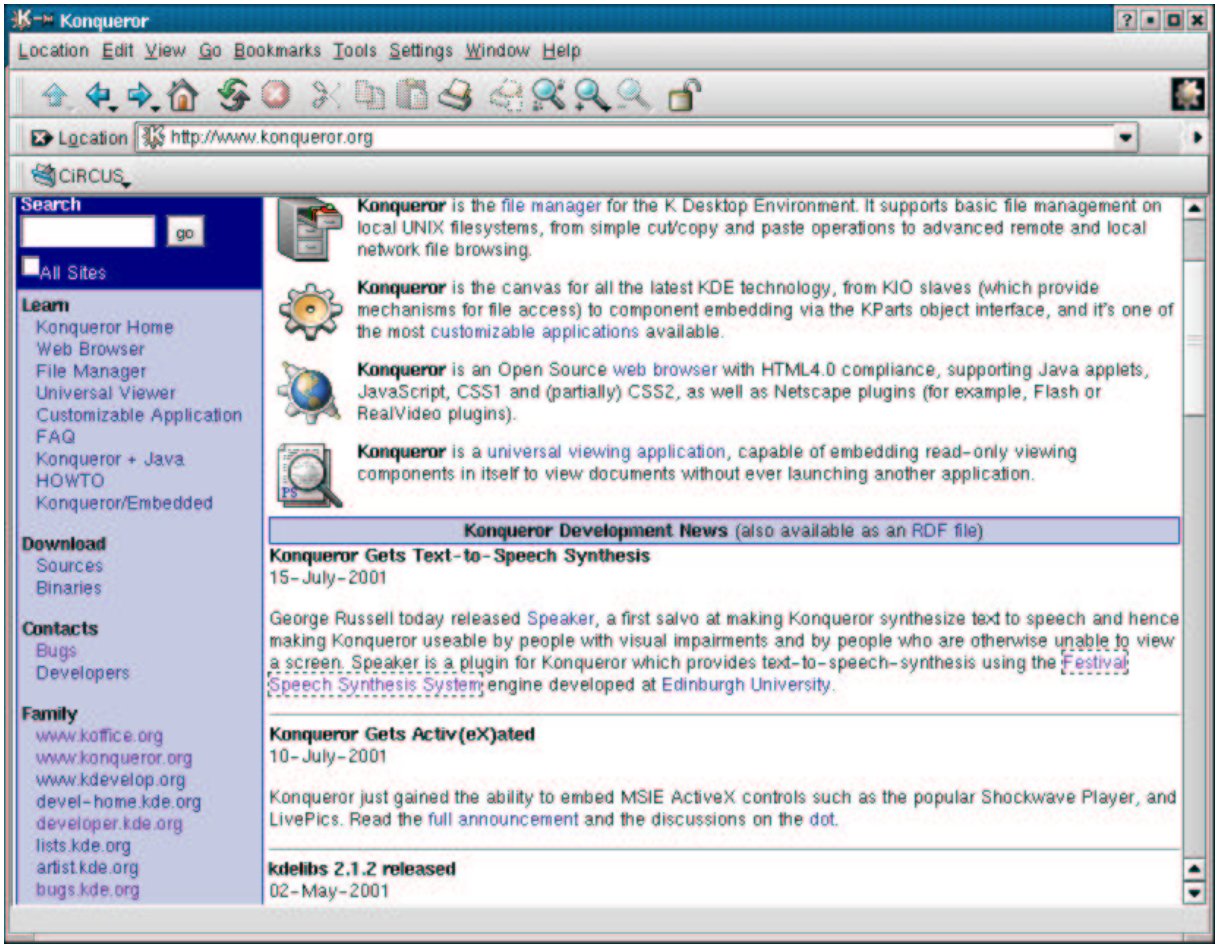

Figure 2: The Konqueror Web Browser

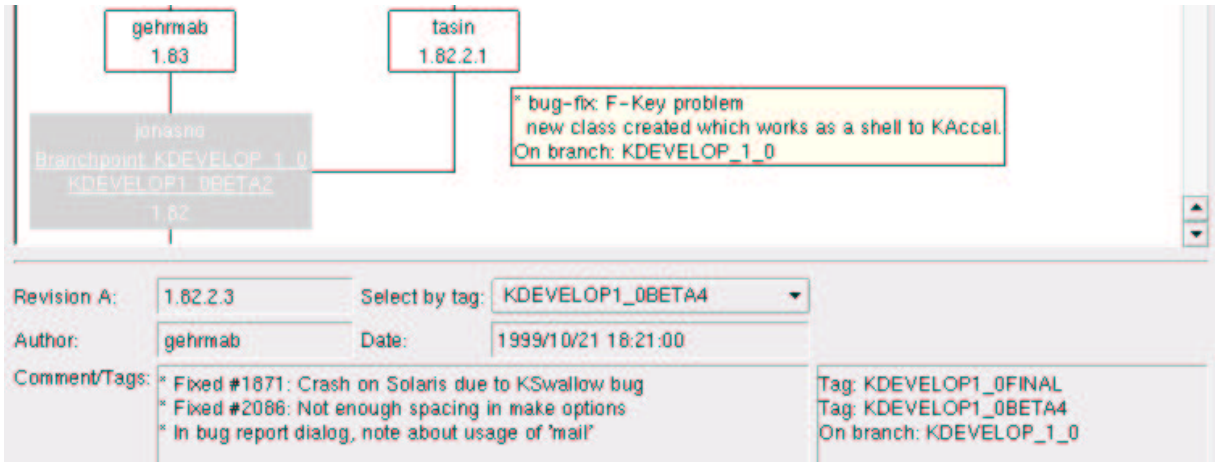

Figure 3: The Cervisia Code Versioning System Front End in Operation

3.4 You can't develop open source products because with no sales, they cannot be supported

There is no restriction of selling either open-source products or support for them.

4 Licences

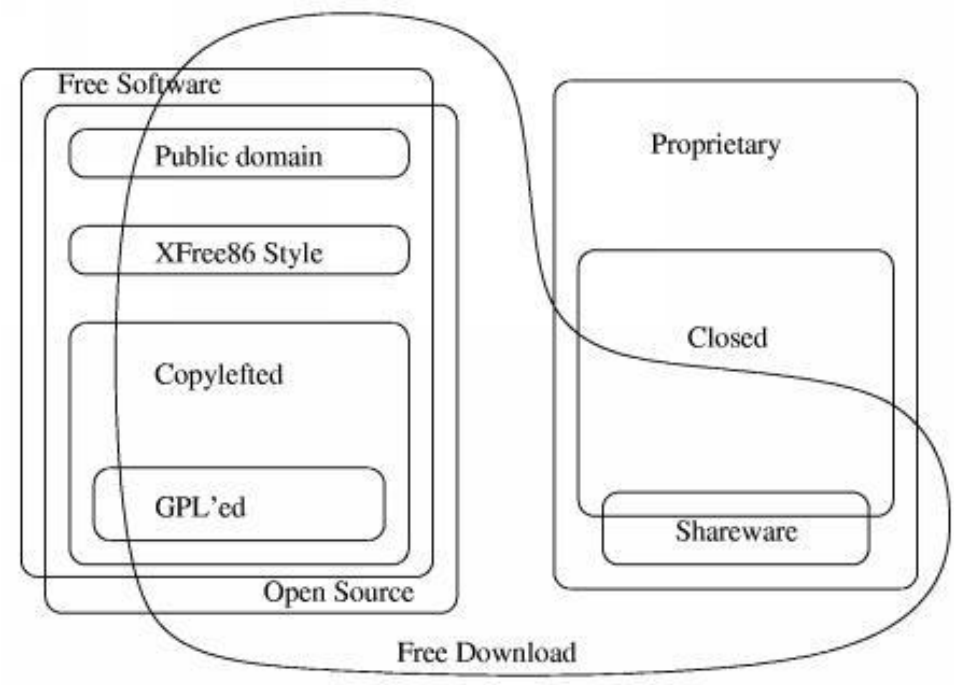

Figure 4: A Taxonomy of Software Licences

The diagram in Figure 4 was drawn by Chao-Kuei and appears on the FSF's Categories of Free and Non-Free Software page.[10] It represents a taxonomy of open- and closed-source software.

The Free Software Foundation's motives are to promote the freedom of others to use software as they please. This motivation has been at the core of the FSF's philosophy since its foundation, but has achieved particular relevance recently by various highly restrictive practices pursued by some hardware and software manufacturers. Notably, some hardware manufacturers (e.g. those manufacturing "WinModems" and some sound cards) began releasing drivers only for Microsoft Windows. Naturally, there is nothing wrong in that, as it is unreasonable to demand they support operating systems used by numbers sufficiently small that they consider the investment unjustifiable. However, the same manufacturers would place restrictive clauses on the use of their hardware, or simply make secret the necessary information for a third party to write software to support their product. It is not clear why they should choose to do this. One has to ask, "will more sound cards or less be sold as a result of increasing the potential user group?". Such reasoning seems to be beyond the grasp of some corporations, however, and there are still many products, not just from the personal computing arena, which have the same restrictions. For example, Manufacturers of Field-Programmable Gate Arrays (FPGAs - devices contain up to several millions of logic gates which can be wired up entirely through software) stalwartly refuse to issue details of the configuration file formats, thus stunting research using such devices in dynamically reconfigurable computing.

From the FSF's advocacy arose the idea that not only was it stupid to apply these restrictions to software, but that it is wrong morally to do so. Their argument is that there can be no such thing as software theft, because "theft" means "permanently to deprive the owner of use" and copying a piece of software, while infringing copyright, does not stop the owner from using the legally copied software. The FSF developed the concept of a legally binding copyright (referred to as "copyleft") which was designed not to restrict the use of software but protect the freedom of its users. The General Public Licence (GPL[11]) permits the work to which it is applied to be distributed freely (in

[10] http://www.fsf.org/philosophy/categories.html
[11] http://www.fsf.org/copyleft/gpl.html

the sense of "free speech") with or without charge, but is radical in that it operates virally. That is to say, it "infects" derived works which must also be freely redistributable, and requires anybody who uses the derived work to make available its source code under the GPL. In doing so, by providing tools and programs without charge which are of very high quality, the quantity of GPL software has now reached critical mass and is increasing fast.

There exist open-source non-proprietary software licences which are nontheless incompatible with the GPL. An excellent survey of licences[12] is available from the FSF's web site. Some authors wish their work to be freely available only to a specific community or for a specific purpose; while this may constitute open-source software in that the source code is made available, it can not be regarded as free software in the FSF sense because a restriction is placed on the freedom of the user to use the software as she or he chooses. Some "shareware" packages fall into this domain.

Of particular interest to the CiRCUS community is the effect of releasing a major piece of software into two different user communities, and watching the behaviour of the groups involved. Dr Mark Spink, formerly a lecturer in the Department of Electronic and Electrical Engineering at Leeds, UK, wrote a significant package to permit the handling of NURBS (Non-Uniform Rational B-Splines). The package was released under the GPL to users of Scilab,[13] a GPL'ed scientific computation package, and Matlab, a similar but commercial package. Users from both communities sent email providing comment, feedback and bugs reports. However, there was a fundamentally different attitude displayed by the two groups. Those from the Scilab camp were more inclined to suggest solutions to bugs rather than merely report the facts, and to contribute code back for new features. This is quite interesting because although Matlab is not an open source package like Scilab, both communities of users do write extensions called toolboxes which very often include source code. Dr Spink personally believes that the attitude stems from a different perception of the code ownership. In the open source community for which Scilab can be included, code is seen as a community commodity with a principle author (leader) where suggesting patches and contributing code is not seen as giving good ideas and work away. However, in the closed proprietary world within which Matlab has been developed, ideas and work are seen more as owned by the author, and they can fix their own problems.

The Free Software Foundation has also been involved in the production of the Free Documentation Licence[14] which is used by at least one large-scale commercial project[15]. This is possibly of interest to circus members in that it covers documentary content which is closer to some members' interests than is software. From the preamble:

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5 Arts and Free Processes

Traditional models of artistic activity are not necessarily compatible with the ideas of interaction. In the conventional process, a composer (or author) produces a work and releases it. Commercial considerations aside, it is not clear why the composer should be entitled to any influence over the work after it has been released, and indeed, the very connotation of the word suggests a freedom and individual existence[16] for the new work of art.

Performers interpret the released work. Most likely, they will be interested in the composer's motivations and intentions beyond those literally expressed in the work, and will listen to the composer's opinions, but their interpretation determines the nature of the performance.

[12] http://www.fsf.org/philosophy/license-list.html

[13] http://www-rocq.inria.fr/scilab/

[14] http://www.fsf.org/philosophy/license-list.html#DocumentationLicenses

[15] The free encyclopædia project, http://www.nupedia.com

[16] UK's Channel 4 recently produced a series, *Beckett on Film*, in spite of the fact that during his lifetime, Beckett consistently refused permission for any of his plays to be filmed, exercising an unusual degree of authorial control over his work. Although arguments could be made against the dumbing-down of the work, did his refusal significantly reduce his potential audience? Is there a obligation of the artist towards the work? or does creation beget duties as well as rights?

The audience experiences the performance. In many cases, reading a work of literature is an example, the audience member and the performer are the same. In music, they are usually different, but this is not an advantage; the performance of chamber works by a small group of amateurs can be at least as rewarding for the participants as being a member of the audience in the concert given by a professional symphony orchestra. This is because of the close interaction of the experience and the interpretation phases of the performance, but it does not change the fact that the performance is actually happening in the head of the listener, and not at the point of contact between the bow and the string nor that of the composer's quill and his manuscript.

In all these processes, except at the purely technical level, the flow of information is essentially monodirectional. Although the performer can change their performance in the light of the sound they hear emanating from their instrument, this is because they are afforded the unique position of being both performer and audience.

If one is to respect the functions of the three stages of delivery in an artistic work, composition, performance and audition, one is to respect the composer's (or in fact the work's?) right to constrain the performance, and the performer's right to interpret, as well as the auditioner's right to perceive. Interaction can (but not necessarily does) interfere with these processes in that the auditioner or performer becomes composer, and changes the work that is individual of any of the three involved in its realisation. Some works actively encourage this process; Jazz or Aleatory music for example, although always within strictly prescribed limits: but for those which do not, any alteration outside of the accepted bounds is a recomposition. Interaction in this sense means the imposition of a compositional process on the performers or participant: a role they may be incapable and/or unwilling to undertake.

The traditional work of art can be described in terms of three attributes of its manifestation: structure; content; appearance. The new media adds a fourth: "behaviour".[17] This enables, or even formalises, the act of interaction. Whereas in the case of the old media, the work is unable to respond to the interaction but is only passively modified by it, the interactive possibilities of multimedia permit the creator to add prescribed behavioural pattern, and to codify, formalise and "require" interaction between the work and the audience.

There is a correlation between the tools, ideals and activities of the open-source community, and the structure, content and appearance of the traditional artwork. Arguably, the computer science background of many of the Open Source Community participants have enabled them to structure their work more formally, strengthening their ideals and activities. Key among the ideals is that of the GPL, which requires freedom of use and sharing of code. Further ideals, such as a pure, fluid and dynamic process of peer review as embodied in the IETF (Internet Engineering Task Force) further strengthen their cause.

In fact, C.P. Snow's "great divide" between the artisitic and scientific process is a misrepresentation and shows an ignorance of what is involved in the act of creating a computer program or designing an electronic circuit. The concept of the divide has become in ingrained in society — students of electronic engineering have objected loudly in the past when I have referred to their activites as lacking in artistic merit, yet would expect such feedback were they studying the subject in a design (*art* and design?) college rather than a University department — but it seems to me that the differences in presentation of scientific and artistic communties are to blame rather than any substantial difference. On the one hand, the artistic community values the individual contribution and the purely conceptual part of the creative process to a greater extent, while the scientists write papers which present the work in a logical sequence of steps even though the actual process, especially in a large system will have benefitted from hunches and subjective opinions. To deny this is as ridiculous as to suggest a symphony or a novel is unplanned and the result of pure sponteous creation. It would be most suprising if the benefits of the hotbed of collaboration which is the free-software community did not have lessons for the arts.

Stallman's speech at MIT this year[18] makes the point that copyrights, like most laws, are dependent upon and arise from a social context. A hermenutic examination of the original purpose of copyright quickly demonstrates that its current usage, essentially to the advantage of publishers before that of the users or originators, is a corruption. Consider this quotation which is just one decade old:

> The primary objective of copyright is not to reward the labor of authors, but "[t]o promote the Progress of Science and useful Arts." To this end, copyright assures authors the right to their original expression, but encourages others to build freely upon the ideas and information conveyed by a work. This result is neither unfair nor unfortunate. It is the means by which copyright advances the progress of science and art.
>
> — *Justice Sandra Day O'Connor* [19]

The issue of *fair use*[20] arises when corporations are permitted too great a power over dissemination. Unfortunately, the Millenium Copyright Act[21] goes far in shattering Justice O'Conner's idealism by essentially removing the right of an owner of an artifact in electronic medium even to lend or show the work to their acquaintances, thus removing all publicity and distribution, along with the associated benefits, into the hands

[17] David Garcia *verbat*

[18] Dr Stallman's speech is avaiable in the open alternative format to "mp3": *ogg vorbis*. The audio file is obtainable from http://www.gnu.org/philosophy/audio/rms-mit2001.ogg, and the player from http://www.vorbis.com/index.psp

[19] Feist Publications, Inc. vs. Rural Telephone Service Co., 499 US 340, 349(1991)

[20] The issue of what constitutes fair use in the publication of electronic texts is discussed at http://www.arl.org/info/frn/copy/fairuse.html

[21] http://www.loc.gov/copyright/legislation/hr2281.pdf

of the publishers.

Formally, patents had nothing to do with copyright. Copyright issues arise when it is essentially free to make copies, such as a recording of some music or photocopying a journal paper. Such copies can be made at the cost of a fraction of that of acquiring the original. As yet, there is no such way to copy a machine or a drug. Nothing has the potential to damage education, scientific research and artistic endeavour more than the proposed introduction of software patents. Even industry stands to be severely damaged by such aggressively antidemocratic, pro-monopolistic regulation.[22]

In fact, not only are software patents unethical, but they are also unpopular. The recently published[23] "Analysis of replies to the Consultation Paper on the Patentability of Computer-Implemented Inventions" showed that 91% of respondents, including SMEs and other commercial interests, were against software patents; the only groups favouring them were composed predominantly of multinational corporations and lawyers. Nevertheless, the EU seems to be veering dangerously in the direction of this anti-democratic, anti-intellectual legislation.

Significant implications clearly exist if we desire to foster cooperation between the artistic and scientific communities. The GPL mentality must be adopted, in the understanding that it promotes the visibility and usage of artistic work without compromising its commercial possibilities. The spirit of the Free Software Foundation is already being adopted by some of the music community in the dissemination of musical scores and editions (as for example at Mutopia[24]) If there is one lesson to be learned from the history of the Free Software Foundation so far, it is that the importance of getting right the terms of distribution can not be underestimated. If commercial interests are allowed to prevail, the World-Wide Web of the 21st century will be another and more powerful method for distributors to control the content of what we view and hear, and not the engine for freedom of speech as it is popularly described.

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[22] http://www.smets.com/it/policy/useright/useright.pdf

[23] http://europa.eu.int/comm/internal_market/en/indprop/softpatanalyse.htm . As the author of the referring page wrote: "Effectively, 91% are against patenting software, but, as the majority of the proponents are important business figures, it's a draw."

[24] http://www.mutopiaproject.org/

[25] Stuts was one of the earliest journalists to understand the motivations of the free software community, and explains further at http://www.dsl.org

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Some Personal Remarks on the Creative Potential of Space (Towards an Einsteinian Turing machine)

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Abstract

The author believes that "art" should be an autonomous process which can participate in a dialogue with the artist, -that the computer is an ideal machine for realizing this dialogue and that "conceptual space" provides not only the ideal set of techniques for its construction but is also the ideal environment for it to take place.

This position is expanded by suggesting that our everyday understanding of space is in fact highly conceptual and probably not at all related to our actual experience of space.

If we are prepared to accept that space is primarily a conceptual construct then we are able to enter the bizarre world which theoretical physics has successfully exploited for many years now.

We then discover that dimensions are not fixed, that space can be folded, cut and joined and playfully manipulated in many ways -and that the way these games are played might be of vital importance because, even though the structure of space is fairly flexible, the structure of the space also has significance.

Not only can space represent a set of potential sensory images, a system for storage or retrieval of data and a physical or conceptual environment for us to explore -space can also be used to process space in many ways, often dependent on the spatial configuration of the elements involved.

However, even if one is not prepared to accept the more extreme claims of the author, then parametrical space may still prove useful in the construction and comparison of conceptual models -by forming a framework within which systems of representation can be developed which could allow artists and others to present "subjective" ideas in a more formal way in order to encourage exchange and discussion to take place within a nexus of conceptual and physical spaces in an open and yet "objective" way.

1 Introduction:

1.1 The Ontological Computer

Although I can understand the commercial and political significance of using digital technology to support interactive systems -I do not consider "interactivity" as a useful basic principle for structuring a discussion on relating creativity to digital systems.

It is not true that computers automatically imply "Interaction": One can easily argue the opposite -that automation means the removal of outside interference -in effect, making the “automated” process pre-defined and truly "autonomous". Indeed, it is the need to pre-define the universe of operation that make epistemology and ontology probably the most important concepts within

automation (even with “self-learning” systems -which still need initial definition) .

It might also be interesting to reflect that what in England is known as "Fine art" -is known in Holland (literally translated) as "autonomous art". This suggests to me that not only is it reasonable for art to be "automated" but also that it should be free of the externally imposed need (by the artist) to carry some form of artistic, political or propagandist "meaning".

On the other hand, it is important not to be too dogmatic: We have a intellectual tradition of divide and conquer and are used to chopping up our experience of the world into separate and manageable problems, but the computer is revolutionizing our lives and is forcing conceptual and practical integration in many areas which have long been considered separate.

Survival often seems to be a question of balance and so total autonomy may be as dangerous and undesirable as being totally under external control.

1.2 Art as Formalization

Although art can be seen as an expression of the artist -it can also be seen as a set of creative techniques which help to transcend the limitations of the individual artist (and perhaps, by extrapolation, the audience). Contemplation is important -and interactivity does have a role in contemplative exploration -indeed, we often like to take unknown objects in our hands in order to investigate them better from all sides and from different perspectives. However, larger objects, abstract ideas and historical processes are more difficult to deal with in this manner and we have to resort to a more metaphorical manipulation in mental space in order to integrate the different conceptual positions.

So I would like to take up on Simon Penny’s suggestion in his position paper and explore the important and magical concept of "space". A concept which often seems to taken for granted while remaining largely undefined and yet almost as ubiquitous as the computer itself.

If you cannot see the point, please do not worry -I am not concerned with making points but with developing spaces.

2 The Nature of Space:

2.1 The Basic Definition of Space

I propose that "Space" is created and defined by the act of defining a set of coordinates: It is the selection and organization of the parameters (or dimensions) which provides the link with epistemology and it is the experience of navigating the resulting space which provides the link with ontology .

In other words, "Space" is simply an "address system" -A way of "finding or retrieving lost, hidden, or invented things" -exactly the way one uses a basic coordinate system to find the university library on the map in a strange town -or the way one can spontaneously stroll the streets in search of serendipity.

This definition of space gives full credit to Descartes for his development of analytical geometry and the coordinate system. However, I intend to demonstrate that this system can be extended far beyond what we (but possibly not Descartes) might understand as being "Cartesian" limits.

In practice, the implications of this simple definition are so great that I can only briefly run through some of them here -hopefully sketching a rich area for further research.

2.2 The Concrete-Abstract nature of Space

An image is generally represented by the computer as a two dimensional raster, we are also used to reconstructing physical space with the help of our sensory-motor system. So it seems that as well as being a system for storage and retrieval of data, a physical or conceptual environment to get lost or found in -space can also be represented in terms of sensory (tactile, visual and perhaps even aural) imagery.

On the other hand, one of the most baffling aspects of multi-dimensional conceptual space is the problem of relating it to our commonplace experience of three-dimensional space -and the difficulties of imagining how extra dimensions would fit in.

It is generally assumed that coordinates must intersect at right-angles to each other -but it might be interesting for us to relax this condition in order to experiment with

other systems which may initially seem useless, stupid and maybe even impossible.

If (for example) "Colour" can be usefully represented by a three-dimensional conceptual model -then surely "colour" must also be a three-dimensional part of our physical universe. Likewise, concepts such as "smell", "texture", "speed", or “density”, etc. -these too must fit into the "dimensions" of the physical universe -just as easily as they can form parameters of a conceptualized universe.

Our traditional concept of three-dimensional physical space cannot be derived directly from our own sensory-motor system. The coordinate systems generated by our eyes, ears and other sensory systems all seem to function slightly differently from each other -although there may also be similarities between them.

Our eyes map space mainly (but not exclusively) through binocular focusing while our aural system uses phase-shifted (time delayed) signals to locate sources within sensory space.

Our arms and legs also help us to move around and explore space -but these limbs are connected in limited ways by different joints that move in complex but specific ways. The control parameters of our motory system must surely be based on our physical body -and yet even the simplest study of robotics must demonstrate that our sensory-motor space is much more complex that the simple three dimensional system of physical space which we are conditioned to believe in.

I strongly suspect that our concept of physical space is dependent on ancient Greek/Egyptian measurement of flat surfaces (possibly originating in the yearly demarcation of arable ground in the Nile valley) -and that these ancient mathematical methods have been passed down (often demonstrated on the flat surface of paper or slate) until we have (regrettably) come to believe that Euclidean space is the only (possible) reality.

2.3 The Intuitive nature of Space

Wittgenstein has remarked that we must remain silent over that which we cannot speak about.

We may therefore suspect that many problems may indeed prove insolvable simply because we have no suitable language to express and explore them adequately. Apart from the problem of inventing things which do not exist, the search for a suitable language (in the widest possible sense of the word) is made even more difficult by the way languages, models and description methods often impose their own ontological and grammatical assumptions onto the subject -easily making them subtle tools for biased propaganda rather than neutral media for research.

Perhaps some form of underlying "political", conceptual or aesthetic "bias" cannot be entirely removed from any conceptual system -but by explicitly expressing the underlying model in terms of the chosen parametrical system the basic assumptions are more openly expressed and is therefore more open to challenge and debate.

When the underlying structure of the representational system becomes more explicit -it can be related more easily to other similar spaces. By facilitating comparison and mapping between systems, a richer, more diverse dialogue becomes possible without compromising individual positions or degenerating into mutual incomprehensibility .

2.4 The Creative nature of Space

If we can accept that "space" is more a conceptual than a physical phenomenon -then we become free to construct it in any conceivable way.

Presumably, each individual constructs their own egocentric mental space which is why we sometimes have difficulties mapping the psychological space of others into our own conceptual space!

If "space" is defined and created by the coordinate system then it seems that a taxonomy of coordinates, including a study of the consequences for the different types of space they generate, would be the first step towards an understanding of conceptual space.

2.5 The Mnemonic nature of Space

At this point, I would like to mention "The Art of Memory" by Frances Yates -a fascinating book on the (spatial) use of Mnemonics as an aid to memory before written language and printed books made human memory largely redundant as a way of preserving large chunks of information.

Within the context of "content" and its potential relationship to "form" Yate's book is extremely important because it clearly demonstrates a wide range of cultural implications (ranging from the architecture of the theater to the interaction between scientific and mystical thought) directly related to the practical use of mnemonics.

I believe it is a great loss that much of that which is discussed in her book is now largely outside our cultural awareness and perhaps even our understanding -simply because the basic techniques of memory described are no longer required to function as essential techniques for preserving cultural heritage.

The interaction between technological, conceptual, cultural and social change remains an important but difficult subject for study. In my view this book presents an excellent set of demonstrative case histories.

3 Processing Space:

Although the use of space as a multi-dimensional "address system" suggests a rather static use -there are a wide range of strategies for creatively manipulating the conceptual space.

One can think of such techniques as:

3.1 Enumeration (combinations and permutations)

Although the decimal system is now in common use there are many other numerical systems which use a different number base than ten. One can think of technical systems such as binary and hexadecimal, but also other systems such as feet and inches (base 12) or the sixteen ounces in a pound weight.

The number of the dimensions of a space and the number of points within each dimension correspond to the number of bits used and the numerical base in a specified number system. So "counting" (in whichever numerical base one chooses) is simply an "enumeration" of all the points contained within the specified space (or, in other words, a combination of all the parameter intersections involved). Because of this -changing the dimensions of a space is really equivalent to changing the number base used to enumerate the states.

It seems that the number of dimensions used to define a space are actually rather arbitrary.

3.2 Set Manipulation

Points, lines, planes and volumes can all be represented as a hierarchy of increasingly complex sets of sets of points.

By considering a set definition to be equivalent to a parameter of conceptual space -all the techniques for forming combinations or intersection of sets should also have equivalent operations in terms of space.

3.3 Folding the Space

Proximity and connectivity between points are essential factors regarding "communication" between points -both in terms of movements through space -or the exchange of messages and information.

Space can be "folded" by changing the order in which the coordinates are interpreted (for example, swapping the interpretation of colour parameters so that {red, green, blue} becomes {blue, red, green}. Such manipulations of the space will change the relative positions of the points addressed by the system, so that in this case the transition required to get from "red" to "dark green" will be changed within the modified colour space.

As a result of changing the space in this way, some points will become closer to each other while others will become more distant -thus modifying the navigational and communicative characteristics of the space involved.

3.4 Analytical geometry

The techniques of Analytical geometry (originated by Descartes) allow the calculation of trajectories and their intersections in space, the estimation of minimum and maximum (optimal) points (or values) of curves, the area of surfaces and the content of volumes.

These techniques have proved valuable in Cartesian space so presumably they might also be interesting to play with in multi-dimensional conceptual space.

3.5 Matrix Multiplication

Matrix Multiplication is currently used to efficiently transcribe objects to new positions in physical or virtual space. It also plays an important role in image processing and neural nets.

A matrix is a small section of space -so space can be used to process space.

3.6 Cell Automata

Cell Automata have applications (as static cells) in image processing, modeling diffusion systems and in simple artificial life systems. However, in the form of movable finite automata they can become independent "agents" capable of carrying out autonomous background tasks -such as searching for information, checking agenda changes and booking your hotel room..

Groups of automata can also collectively form environmental ecologies which can evolve into more complex systems by a process of natural selection.

Connected together in the form of neural networks with feedback, simple automata also can become capable of processing poorly defined information and developing a wide range of self-learning processes.

Such automata not only process space but are themselves defined in terms of their spatial organization.

3.7 Pattern Matching

Perhaps it is not unreasonable to assume that "pattern" is a quality involving (statistical?) regularities (and perhaps irregularities) in the organization of space and that the recognition of "pattern" plays an important role in cognitive processes.

4 Structure and Meaning in Space:

In discussing the relationship between structure and meaning we seem to be faced by a strange dichotomy -because structure often has a meaning and meaning generally implies some form of structure.

I will try to give some pointers towards different ways in which conceptual spaces might contribute towards dealing with problems concerning meaning and structure -which at the same time might help to clarify the relationship between the two:

4.1 Look-up Tables

The Mnemonic use of memory described by Yates may represent the first historical use of mental "look-up tables".

The technically linear space of the computer random access memory, can easily be addressed in terms of any number of conceptual dimensions which the computer can then automatically convert to a one-dimensional offset in order to find the correct position in digital memory. Printed tables such as bus time-tables, temperature charts and currency converters work on the same principle as digital look-up tables, although they are usually restricted to fewer dimensions than the maximum the computer can handle.

Multi-dimensional addressing can be an efficient way of storing, retrieving and converting data.

4.2 Information and Identity

Interpreting "Information" requires detecting both essential differences in transmitted signal and in determining the "significance" of these differences.

Subtle variations in similarity and difference also form the basis for identity and identification.

By specifying the dimensions we can specify exactly in which areas there are differences and which areas there are similarities. Comparisons between parameterized spaces should be a relatively simple process -especially in potentially confusing situations where some parameters are almost identical and others are radically different (i.e. when dealing with problems involving such questions as "Are modern media similar or different to traditional media?").

If we can represent the same phenomenon in different conceptual spaces -which represent the various conceptual contexts (or domains) in which the subject may be manifest -then a nuanced and well-founded discussion should be facilitated if we can map between these different representations.

4.3 Association

The advantage of "space" as opposed to a “set” as a representational metaphor lies in the fact that the "coordinates" of space intersect and are not nested -so navigation through the semantic space becomes much simpler.

The idea that the points in space can have a "meaning", combined with the idea of "moving" from one position or location to another via a series of connecting parameters, suggests that when working with ordered space the "association" of similar concepts or ideas should be more efficient than with unordered sets.

i.e. in space, all the "red" objects will be found along the "red" dimension -and all the "round" objects along the (round) shape dimension. So we can easily guess where a "nice red juicy apple" will be found -and what might be next to it, in different directions -if we know the nature of the space involved.

Obviously, large variations are possible (based on functional, cultural, pyschological, perceptual or historical differences) in the nature of the conceptual space which might be constructed around the point labeling (or defining) the concept “apple”. Although the manipulation of space may be “objective” -the definition of space can be completely “subjective”.

4.4 Geometry and Topology

Within a space, one may refer to the "geometry" of the space -i.e. characteristics which reflect the connectivity between points within that space. For example, are the connectivity rules homogeneous (as on a flat surface) -or are there variations depending on (local) circumstance -such as the differences between the number of "shortest routes" demonstrated by great and small circles on the sphere? Can all the points be connected to all the other points as on a Mobius strip or are there barriers in between? These kind of questions are vital in determining the "geometry" of a space.

Comparisons between spaces are generally considered to be questions of "topology" -which essentially asks if one space can be "converted" into another by "conceptually" stretching or compressing (but not tearing) either of the spaces.

A comparative topology of multi-dimensional space should be a valuable tool for the understanding of conceptual similarities and differences across temporal, media or disciplinary boundaries.

4.5 Grammar and Language

If all the possible "primitives" of a language are ordered in a conceptual space, then the "grammar" of that language could be seen as representing the "connectivity rules" determining how one point in space may be connected to (or combined with) another. So the construction of a "compound" is then relative to the movement, or trajectory, through the specified space under control of the relevant grammar.

The concept grammar thus becomes linked to the concept of topology.

If "language" becomes primarily involved with "movement" in space -then presumably "interpretation" will be concerned with reconstructing this "ballet" in conceptual space -in order to discover its significance.

4.6 Complexity

One form of complexity is generated by "nesting" of concepts or terminology.

In other words, the formation of a "Gestalt"-when a compound in one system becomes a primitive in another system -or a complex space becomes represented as a single point within an encompassing (meta)space.

An interesting manifestation of this "nesting" is when the nature of the space/point changes depending on which level one is looking at. Examples might be the difference between the computer as experienced by a programmer and as experienced by a non-technical "user" -or the difference of effect when applying a steam engine as a static source of industrial power within a factory or making it mobile on a set of rails -which, in turn, might be rather similar to the difference between a stand alone computer and one in a network.

One may suspect that "great philosophical texts" are often written at times of change -sometimes on the basis of a sense of loss regarding what is passing -but also because we often only become conscious of things when they change. If the multi-dimensional parameters of social and technological change could be represented within a single set of interconnected conceptual spaces then the description and study of the interaction between these processes might be much easier.

5 Sculpting in Space:

Presumably, it would simplify comparison and understanding of a wide range of phenomena if many conceptual and physical processes could be described in terms of operations involving conceptual space.

Furthermore, we could probably describe these operations as belonging to the following categories:

5.1 Construction/definition of space

Involving either the construction of conceptual models based on existing phenomena or the invention and investigation of new spaces which have no known parallel elsewhere.

5.2 Operations on or within space

Involving "cognitive" operations within a space or the generation of new spaces through the modification of existing conceptual spaces.

5.3 Comparisons and Mapping between spaces

Involving operations concerned with comparisons between (potential) similies, simulations and metaphors but also mapping or translations between different conceptual domains -possibly relating such things as physical and mental phenomena, social and technical effects, the modeling of trans-disciplinary problems, the interpretation of technical data or the mapping and interpretation of sensory data.

6 Using Space as a Creative Generator:

6.1 Extrapolation

At school, I remember being fascinated and impressed by the way in chemistry the "Periodic Table of Elements" allowed the characteristics of elements to be specified, through extrapolation of the characteristics found in the table -even though some of these elements had not yet been discovered in what is generally referred to as the physical universe.

Presumably, such extrapolations could be applied more extensively and systematically to assist in the creative generation and manipulation of new systems of knowledge or universes of experience.

6.2 Mapping

Another important creative strategy is to transfer, or map, a technique from one medium or context into another -but what represents the essence of a technique when it has been removed from its context?

I guess this is basically a question of abstract topology.

6.3 Communicating

The conceptual nature of space makes it an ideal tool for explicitly representing subjective or non-existent phenomena thus "objectifying" them -thus facilitating their exploration and investigation by others -by permitting one to move more freely between existing and invented systems without getting confused as to which is which.

By mapping our individual conceptual spaces into more explicit systems we enable others to enter and map our private mental space into theirs. If this is a mutual process then participants can contribute to the creative dialogue by developing a collective "dance in space" which as it grows becomes a new universe of referential experience for those involved -and possibly a point of reference for others.

7 Expanding Space:

7.1 Touring the Automated Space

The "Turing machine" is a basic conceptual model of the computer.

Basically, it moves through memory, and re-writes the symbols found there according to pre-defined rules which govern both the transformation of the found symbol and the new position in memory where the new symbol should be stored.

7.2 Einsteinian Time/Space

Space generally suggests the idea of movement while, in turn, movement (presumably) generates space.

The concept of movement begs the question of what causes the movement? Is it, for example, internal "animism" (some kind self motivating force or will) -an external agent (operating in terms of an interactive device) or something else (as yet unexplained).

Physics distanced itself from animism a long time ago -so the "passive" conceptual space favoured by physics may not easily relate to social systems which are assumed to involve "actors" with internally organized free will.

However, Einsteinian Time/Space specifies that an object moving through space modifies the space as it moves.

So, if we consider the memory utilized by a Turing machine as a (one-dimensional) space -then we may suspect that it is also a (one dimensional) Einsteinian Time/Space machine!

Although this sounds pretty obscure and exotic -we should remember that originally time/space was intended as a representation of gravity, so it may be so that it simply represents a "force field" such as may be found in daily life in the form of gravity or magnetism, etc...).

It may also be possible that people are more influenced by (mental) force fields than by "free will" -so perhaps an Einsteinian Turing machine could prove an effective medium for the exploration of the dynamics of psychological space.

However, conceptual force fields are not limited to individual psychology -perhaps they can also be used to model social questions such as the relationship between "technological/commercial push" and "creative/consumer pull".

7.3 Dialectical Parameters and the Logic of Aesthetics

Although parameters are generally considered to be linear -it is also possible to construct space on the basis of “dialectical” parameters (expressing a scale of positions between two apparent opposites -such as static/dynamic, rational/intuitive, conceptual/physical, etc.).

If we could imagine a dialectical Meta-space, such that each point within the space represents (or specifies) sets of axioms (specified by the dialectical coordinates of the meta-space) -then each of those points would represent a (formal, semi-formal or even informal) conceptual system with various characteristics.

If this “dialectical Meta-space” can be accepted, then "Aesthetic choice" might be seen as being a basically arbitrary choice (i.e. it cannot be derived via any rule based system) -which is (nevertheless) capable of generating "rule based systems" which have "logical" (i.e. derivable) consequences for those operating within such a system. Analogue to systems derived from formal axioms, modifying these arbitrary choices will generate a new system different from that generated by previous sets of choices.

If this is true, then we should preserve these aesthetic (cultural) alternatives as carefully as we preserve biological variation. In order to preserve conceptual diversity, it is essential that we do not allow the "Flat" space of western culture and the way it excludes alternatives to seduce us into degenerating into aesthetic , conceptual and cultural homogeny.

Aesthetic research, involving a study of the (aesthetic, logical and practical) implications of systems derived by aesthetic choice -practiced on both a practical (artistic) level and a theoretical (meta-) level -could make a significant contribution to a better understanding of the relationship between theory and practice.

7.4 Art in Space:

I suppose music has always been involved, more than most of the other art forms, with (abstract) movement within sensory and conceptual space -and with the link between the two.

Maybe the complexity of the mapping involved was why the ancient Greeks valued music so much. Possibly this complexity is related to the reasoning behind the attempt of Xenakis to liberate musical sound, many years ago, by changing to a set of parameters based more on the science of physics than on traditional music. What a pity this attempt failed -presumably because his attempt to apply parametrical conceptual space to

an artistic process became too strongly associated with aleotoric serialism to receive the full attention which it perhaps deserved.

Although the removal of artificial (mechanical) instruments in the production of music is almost unthinkable, -until fairly recently, the production of visual art has been almost entirely by hand and because the cinematic and theater arts have largely focused on content and story telling -the implications of parametrical conceptual space were presumably irrelevant outside the field of music -until computer systems began to force the issue.

Unfortunately, the rejection by contemporary culture of almost any type of formalism -or universally accepted meta-language -encouraged by the cultural split between science and art has not prepared the art world in any way (with the possible exception of music and dance) for the advent of the computer. In fact, exactly the opposite -it is only the De-formalization of the computer, and the denial of its essentially formal nature, which has made it acceptable to the art world.

Considering the consistent and extremely successful use of parametrical conceptual space by the practitioners of physics over a considerable period of time, it is strange and regrettable that although words such as "parameter" and "space" have crept into the language of cultural theorists, there appears to be very little concerted effort to develop a real understanding of these terms and their implications for the creative arts outside the reincarnation of renaissance pictorial space.

7.5 Simulation:

Science is strong on the testing of models but is (with a few exceptions -such as the abstract formal systems found in mathematics and logics) generally weak on "scientific" methods for the construction of models -which is generally left to the "intuition" of the scientist.

Art is rather weak on the testing of models (often pragmatically testing them by relying on the sympathetic "intuition" of the public) -but it has developed (both collective and individual) artistic strategies for the generation of artistic models (i.e. specific genres and works of art).

Simulation allows direct (ontological) experience of a model (without epistemological mediation). The simulation of complex ontologies is probably a major link between art and science -which, because computer simulation increases the participatory (experimental) aspect of science -will probably become even more significant in the future.

8 Conclusions

I strongly suspect that practical investigation will confirm that parametrical conceptual space can be a valuable tool for the non-reductionist analysis of complex and perhaps paradoxical systems -allowing structural (topological) comparisons between different universa of practice or experience which can also be applied (if desired) within the context of a generative framework for dynamic creative systems.

How much more efficient it would be if we could describe a wide range of mental and physical phenomena within a single language -without detracting from the fundamental nature of the phenomena involved by forcing upon them an unsatisfactory structure as the price to pay for the integrating translation. I believe that "parametrical conceptual space" is flexible enough to allow us to do this -because the space can be tailored to fit the phenomenon being described or modeled -and not vice versa.

If "intelligence" can be reduced to the ability to create, manipulate and map conceptual space -then we would have at our disposal a powerful conceptual medium for exploration, understanding and manipulating the interrelations between structure and meaning.

"Parametrical conceptual Space" may be an essential paradigm for dealing with content within the context of integrated research into creative user systems. If we are to connect the dots and find the patterns in a useful and meaningful way then we shall need the space to do it.

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Between Technology and Creativity, Challenges and Opportunities for Music Technology in Higher Education

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Abstract

A presentation at Bath Spa College University in June 2001 gave me the occasion to rethink the existing Challenges and Opportunities of Music Technology within Higher Education today. To integrate an interdisciplinary field, such as Music Technology, into an academic discipline-segregated structure, such as that existing in our Universities, provides, in many ways, more challenges than opportunities: in research as well as teaching and administration. This report will present an overview of this situation, fed by my personal and professional experiences working with or in various academic institutions. Several working groups and workshops, such as the EC funded CIRCUS project (Content Integrated Research into Creative User Systems)[1], the invited EPSRC Music Technology workshop[2] as well as the invited EC "creativity and technology"[3], have addressed relating issues of teaching not only music technology but other creative courses in HE, with the result of giving this paper an even broader perspective. Although this is within a European context, most issues are possibly restricted to the British continent. In this light, this report tries to provide a deeper understanding into the inherent problems and the immense potential in which this discipline is currently standing: a potential which many universities are managing to exploit to a great academic benefit. The report will cover an initial attempt of defining the area of "music technology" within a realistic academic context, and subsequently look at some challenges of teaching this discipline within HE institutions. The changing face of research funding opportunities are sketched and described, and a conclusion based on this discussion is attempted. These conclusion or recommendations, although here specifically relating to Music Technology, imply for similar recommendations to be implemented and tried in other multi-disciplinary, technology driven and creatively pulled subjects.

1. Between Technology and Creativity: Music Technology, an interdisciplinary new discipline?

1.1. Our Students – Music Technologists of the fourth generation

The discipline of Music Technology, if it is such a thing as a "single" discipline, has already acquired a relatively long history. Seeing our students in HE institutions as a part of this history shows how much we, as teachers and learning facilitators, still need to learn in order to teach this new academic discipline within our own institutions.

Our students could be considered the “fourth generation” of music technologists. Oversimplified, the first generation of Music Technologists could be called the "Experimenters" of the 50s and 60s, with individuals such as Pierre Schaeffer, Karlheinz Stockhausen, Herbert Eimert, John Cage, Robert Moog, Donald Buchla, Max Mathews, Lejaren Hiller, and many more. For the first time a critical mass of technologists and musicians looked at music and technology and tried to develop their own methods of combining aspects of previously different disciplines into one.

In the danger of continuing this oversimplification, the second generation of the 70's and 80's built on the basis of the first generation, and with a fast developing commercialisation as well as academic endeavour in this area, the speed with which music technology was developed, produced and utilised in works of art accelerated. Centres were created and individuals like Pierre Boulez , J.C. Risset, Barry Vercoe, Trevor Wishart, Miller Puckett, Gottfried Michael Koenig, John Chowning and Morton Subotnik, provided a wide variety of activities within this discipline.

The third generation of the 90s and 00s was able to position first lecturers of music technology into academic institutions. Music technology was slowly becoming an academically viable discipline of education and research. More well-known individuals of this generation such as Roger Dannenberg, Stephen Travis Pope, Todor Tododorov could be named, among many. For the first time a critical mass of individuals, who had studied more than one discipline and who had a background in more than one field, existed to push this area forward. (My fellow lecturers and I belonging to this generation.)

The fourth generation can be seen to be our current student body: students of interdisciplinary music technology degrees, such as BMus in Music Technology, or the BEng + Music as taught in the University of Glasgow. These are the first body of students who are studying music technology as one discipline or as one degree.

These degree curricula are of a multidisciplinary nature, but are still given as if they fit seamlessly into our traditional, discipline-based academic structure. Sometimes we, the lecturers, course developers and degree managers, forget that these are degrees which do not

[1] Content Integrated Research into Creative User Systems. EU Working Group 1998 – 2001. http://www.circusweb.org Last accessed 13/06/01.
[2] EPSRC - Engineering and Physical Sciences Research Council. Workshop on “Funding of Music Technology”, Harrogate, Febr. 2001.
[3] European Commission - Workshop, FhG Darmstadt, May 2001: "Technology platforms for cultural and artistic creative expression”

have a long standing tradition on which practices can be based, and that we are ourselves are still in the process of learning how to best facilitate the provision of these new degrees. Glasgow University is best placed in this respect, as it has one of the oldest music technology degrees in Britain: the BEng + Music. Nevertheless, the challenge exists concerning how best to integrate an interdisciplinary field into a disciplinary framework.

This challenge exists on all levels of academic endeavour: from the running of these courses and its administrative frameworks, to the teaching and facilitation of learning, the disciplines' pedagogies and specific vocabularies, and its research with its own particular methodologies.

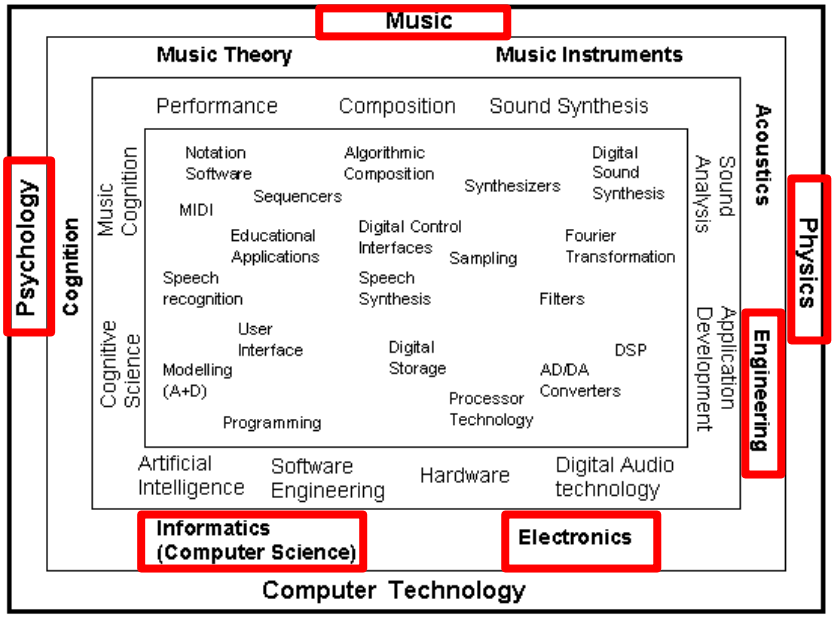
1.2. Music Technology, defining an academic Discipline

To teach or facilitate the learning of music technology within HE, a corpus needs to be a defined: a taxonomy of issues belonging to this subject, and a definition of the borders of this discipline.

Interdisciplinary subjects such as music technology are almost impossible to rigidly press into a specific corpus, resulting in the disadvantage of not allowing change or development. In addition to its current developing nature there are varying views of this discipline, which allow for a variety of academic degrees to emerge: the engineer's point of view is facilitated by a "B.Eng. with Music", the Musician's View possibly by a B.Mus. in Creative Music Technology, and so on. Nevertheless, if this discipline is to exist successfully within current HE institutions, there is a need for institutions to explicitly formulate teaching-content responsibilities according to faculties, departments or schools, and it requires those involved to lay down and quantify the amount of knowledge, i.e. create a corpus and thus define a discipline.

Above is Philipp Ackerman's visualisation of the discipline[4]. Many such visualisations of taxonomies exist, amongst them the simplified version of Richard Moore of "Arts + Science + Technology", and his more detailed visualisation of a music technology pentagram[5] with Engineering, Computing, Music, Psychology, and Physics.

One of the most detailed taxonomies is the one edited by Stephen Travis Pope[6] with subsequent additions and changes from contributors. This has become the classic



Philipp Ackermann, Computer und Musik, Springer Verlag, New York, Wien 1991

taxonomy to be used in education of music technology, due to its comprehensiveness. Below in Fig.2 are listed the first two levels of this taxonomy.

1. Music theory, composition, and performance
   - 1.1. Music theory, sociology, and aesthetics
   - 1.2. Composition of electroacoustic music
   - 1.3. Algorithmic and computer-aided composition
   - 1.4. Performance situations and interfaces

2. Musical acoustics, psychoacoustics, perception, and cognition
   - 2.1. Musical acoustics and psychoacoustics
   - 2.2. Music perception and psychology
   - 2.3. Music understanding and cognition

3. Musical signal and event representation and notation
   - 3.1. Models of signals and events
   - 3.2. Musical event description languages
   - 3.3. Musical signal description languages
   - 3.4. Music notation and printing tools

4. Digital control and sound signal synthesis and processing
   - 4.1. Sound synthesis methods
   - 4.2. Time- and frequency-domain signal processing
   - 4.3. Sound spatialization and localization
   - 4.4. Machine recognition of signals and events
   - 4.5. Real-time processing and scheduling
   - 4.6. MIDI and control processing

5. Hardware support for computer music instruments and tools
   - 5.1. Hardware for DSP and digital audio
   - 5.2. Computer music workstations
   - 5.2. Input/Output devices for music

6. Computers in music education, and computer music education
   - 6.1. Computers in music education
   - 6.2. Computer music education

Fig.2 Pope's proposed taxonomy to two levels (cont'd next page)

[4] Philipp Ackermann, Computer und Music, Springer Verlag, New York, Wien, 1991, p2.
[5] F. Richard Moore, Elements of Computer Music, Prentice Hall, New Jersey 1990. p 24
[6] Stephen Travis Pope, Foreword, in Computer Music Journal, 18:1.

7. Computer music literature, history, and sources
   7.1. Bibliographies/diskographies
   7.2. Studio reports
   7.3. Descriptions of compositions
   7.4. History of electroacoustic music

Fig.2 Pope's proposed taxonomy to two levels

All of these lists and visualisations of taxonomies enable us to define what exactly should, needs, and could be taught within academic degrees of music technology. This discipline is a very fast moving field and its corpus may, for many years to come, be a moving target. Its interdisciplinary nature allows it to locate itself within new combinations of old disciplines, binding them together into a new opportunity of gathering insights to new knowledge, and providing the opportunities to feed back into the knowledge of traditional disciplines. The challenge lies in the successful integration of such an interdisciplinary subject as "Music Technology" within a discipline-based educational framework.

2. The challenge of Institutional Frameworks

Music Technology has traditionally been placed within Music Departments, especially in Britain, where the tradition of "computer music" became a strong influence in contemporary music, taking up the momentum where the German "Elektronische Musik" left off. Music in itself, of course, has had its place traditionally in Arts/Humanities Faculties, and in a few Universities, Music has been able to exist within its own Faculty.

2.1. Music Technology within the framework of Arts and Humanities

The academic discipline of "Music" within British Universities has the tradition of being a practice-based discipline. This characteristic is not shared with the majority of European countries, but has greatly contributed to Britain's high attraction for overseas and European students, and has probably contributed to its successes in the music trade: Britain has a market share of 10 – 15% of the world trade of records[7]. The notion of "learning by doing", with performance and composition being methods of attaining a higher level of understanding of music styles or music activities, has more in common with other vocational disciplines, such as design, practical arts and also the "lab-based approaches" found within engineering and computer science studies.

Thus, the fact that Music Departments in Britain generally tend to be located within the Humanities can provide a point of friction, where methodologies between the more historical and analytical disciplines clash with more vocationally driven disciplines. Especially in times when universities' financial resources are stretched, the tendency to adopt the "German Approach" of 'Musicology at Universities' vs 'Music in Conservatories', seems to be an acceptable solution. A very fractured understanding of the disciplines themselves can and will undoubtedly result, as will a very divided community of "theorists" and "practitioners". This is something which Britain has managed to avoid almost completely, to the success of its own music communities and academic endeavours. For such a new discipline as Music Technology, the fracture represented in the "German Approach" becomes critical, with "Theoretical" music technology ("Musikinformatik") being generally located within Universities under "Systematic Musicology" and Electro-acoustic Composition being located within conservatories.

This division, as existing in Germany, tends to have the effect that universities are left with the degree of musicology - not music - with its academic traditional historical, analytical and theoretical - but not practical and creative - approaches to the field: these approaches being well understood within the humanities. Music Technology, which is heavily driven by creative processes, tends to be ill-placed in this environment as it is solely used as another tool for analysis of music or analysis of musical activities.

The need for joining theory and practice in music education has been a classic requirement, explicitly discussed and mentioned throughout history, and can be traced as far back as the Greeks. (Strangely enough, as soon as a computer is involved in academic activities, most disciplines think it useful to utilize "learning by doing" methods, but this thinking does not transfer itself to other instruments of learning, such as musical instruments or composition.)

Practice-based disciplines, such as the British music degrees, are often located within a faculty in which not only the understanding of its practice-based approaches might be missing, but moreover, where financial constraints can force departments to adopt more conventional (and low-cost) approaches to its own discipline: contrary to the British tradition of practice-based music degrees. Consequently, the attraction that British degrees have on a European scale can be lost.

Within Britain it has finally become standard practice to accept musical activities, such as performance and composition, as valid outputs of research (see the newest "Research Assessment Exercise" (RAE) specifications), but nevertheless, institutions still tend to often mistake the method with the learning objective of practice-based aspects of this discipline:

As you would expect in conservatories, performance and composition is aimed towards delivering professional quality. However, in the degree courses often existing in universities, the involvement of performance and composition is also used as a tool to attain a higher

[7] Figures taken from the British Government's Department of Culture, Media and Sport, http://www.culture.gov.co.uk/creative/index.html Last accessed 21/06/01.

level of understanding of the material being dealt with. If this vital difference is not understood it can be difficult to justify the more costly activities of performance and composition within Universities, which often do not have the remit to train future performers and composers. The notion of "learning by doing" is conveniently forgotten in the light of cost-saving decision making processes. Not illogically, these issues are understood and accepted much more within engineering and computer science contexts than in the Humanities: furthering the difficult positioning of Music within an Arts and/or Humanities framework. Consequences of this can be seen in the phenomena of discussing the closing down of Music Departments in the light of Conservatories existing within the same city.

For Music Technology as a discipline often situated within Music Departments or Music Faculties, several additional issues present themselves. The practice-based elements of its academic activities are understood, as described above, however the methodologies for research into music technology are very different from music, and as such can be very difficult to understand if coming from a point of view used to traditional music research approaches.

Music Technology research methods have always been closely related to, and adopted from, the science-based disciplines such as engineering and computer science. Characteristics of this research include:

- emphasis on teamwork and collaborative projects
- "creative pull" projects
- multi-institutional R&D projects
- commercialisation aims and industrial collaboration
- involvement in technology developments with international consequences, such as standards development, basic research, long-term research
- involvement in a wider diversity of funding schemes
- ability to draw on a wider variety of funding bodies
- ability to attract more industry sponsorship
- more opportunities for large scale projects
- more possibilities for industry-bridging activities for universities

These approaches do not necessarily remain only within research areas, but as can be expected and desired, feed back into teaching, utilising teaching methods such as:

- large and paired team projects,
- creative productions which include technical development
- industry relevant assignments,
- industry placement,
- industry funded/supported projects
- etc.

As a result, difficulties can occur when needing to assess research and teaching within one set of criteria, such as for RAE (Research Assessment Exercise) and QAA (Quality Assurance Agency).

Lastly, but possibly one of the biggest challenges existing for Music Technology today, is that the introduction of music technology into many music departments has created, what has been called a "Trojan Horse" complex. The rising interest of music technology has been met by a general decline of financial support for arts-based subjects in the last decade or so. This means that Music Technology within a Music department can be seen as resource-hungry: a costly but very popular activity - further fed by the music industry's need for specialists in this area. This results in a situation in which many Music Departments have had to decrease the size of their total teaching body, but increase the number of staff active in music technology. With the ratio of "music technology staff to musicology staff" rising, inner-departmental long-term strategies might not be able to be set without conflicting interests and tensions arising from having to distribute the limited amount funding.

2.2. The Trials of Institutional Frameworks, an example: University of Glasgow

Taking the University of Glasgow as a working example of teaching Music Technology at Undergraduate and Postgraduate level, most of the above described issues can be demonstrated.

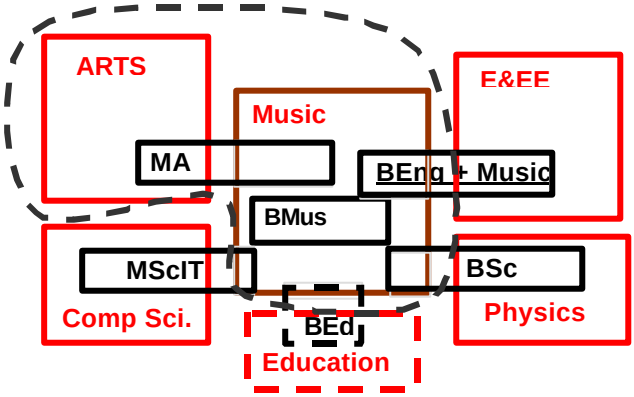


Fig.3 Music Technology within Glasgow University

There are several degree programs that have incorporated smaller or larger parts of Music Technology into their curriculum. If only taking the Honours degrees into account, the list of available courses which have Music Technology modules integrated into them is:[8]

- **BEng + Music**, a 4-year degree with 1/3 Music and 2/3 Engineering, collaborating Faculties of Arts (Music Department) and Electronics and Electrical Engineering (Electronics Department). Similarly the **MEng + Music**, which adds a further 5th year to the normal BEng + Music, with slight changes in the fourth year to add emphasis of Business management and Business studies. The BEng and MEng + Music provides knowledge and understanding of the theory and practice of music technology and

[8] Numbers are taken from estimates of the sessions 1999 – 2001 and are averaged

provides students with the opportunity to develop transferable skills particularly useful to professional engineers within music technology related industries.

- BEng and Music in all four years are ca 90 - 100 students, (FTE 30 – 33)
  - of which all take Music Technology Options = 100%
  - Music Technology within the BEng + Music accounts for ca 120 credits of total of 560 credits = 21%
- MEng + Music in the 5th year are ca 5 - 7 students,
  - of which all or most of them take a Music Technology placement with Music Technology supervision = 100%
  - Music Technology within the whole MEng accounts for 180 credits of total of 680 credits = 26.5%

- **BMus**, a 4 year degree programme based 100% within the Music Department, provides a broad vocational course of study as preparation for the musical profession in the broadest sense of the word
  - BMus in all four years are ca 50 students (FTE 50)
    - of which ca 1/3 take music technology options in their degree = 30%
    - Music Technology courses within the BMus accounts to ca 60 credits of a total of 480 credits = 12.5%

- **MA (and Physics + Music)**, a 4 year degree between the faculty of Arts and the Music Department, provides a flexible modular programme for those who wish to study Music within the context of an inter-disciplinary degree
  - MA in all fours years are ca 130 – 150 students (FTE 65-70)
    - of which ca 1/3 are allowed to take music technology options (quota) = 33%
    - Music Technology within the MA accounts for ca 60 credits of a total of = 220 to 340 credits (depending on joint or single honours) = 27.3% to 17.6%
  - MSci of Physics and Music accounts for only ca 5 – 7 students in all fours years and is included in the numbers above

- **MScIT**, a one year postgraduate degree in Information Technology based in the Department of Computer Science with specific single modules coming from other departments such as Music. It includes a 6-month project at the end of this one year period.
  - MScIT students who were allowed (quota) to take a Music Technology option (from 1999/00) = 10
    - of which all of these took only Music Technology courses within the Music Dept = 100%
    - Music Technology modules within their MScIT degree makes up 1 unit out of a total of 13 units = 7.6%
  - MScIT students who were allowed (quota) to choose a 6 months Music Technology related project (from 1999/00) = 2
    - of which both took Music Technology supervision and courses = 100%
    - Music Technology modules (incl. supervision of project) accounts for 4 units of a total of 13 units = 30.76%

Music in the University of Glasgow is located within the Humanities/Arts Faculty. (see dashed line in Fig. 4) Collaboration between the Education Faculty and the Music Department due to relocation can be expected in the near future.

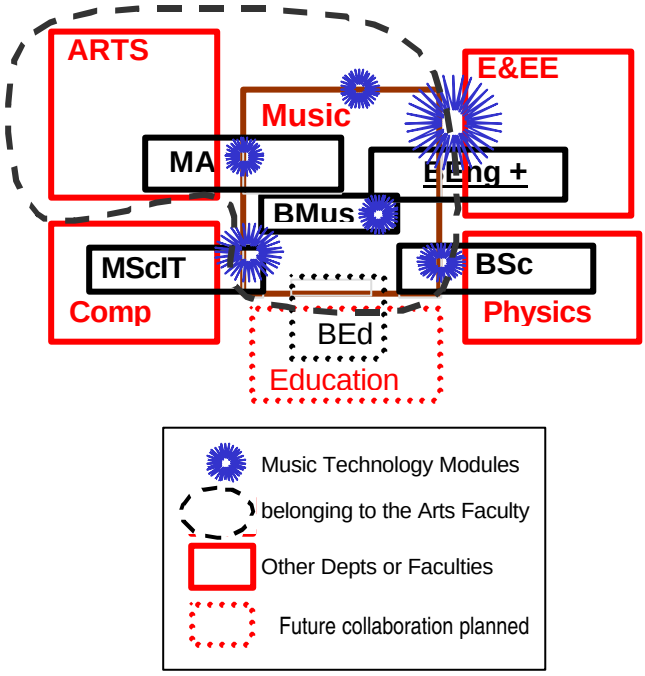


Fig.4 Music Technology within Glasgow University

As most of the Music Technology courses are under heavy constraints due to a limited number of available staff and available resources, quota or entry restrictions are in force for the majority of modules. The quota for the BEng and Music intake is currently set at 25 per year, and the entry restrictions for Music Technology courses for MA and BMus are currently set to allow a maximum class size of 30. Quotas and restrictions can pose difficulties for educational objectives. Certain skills, such as computer based music notation and basic digital editing and sequencing, should actually be taught in the first years of the BMus/MA course in order to act as supporting tools for further activities within the music department. However, due to the need for keeping numbers lower than the existing interest, such skills are only able to be taught to a fraction (1/3 MA and 1/2 of

BMus) of the students, and only to 3rd and 4th year students. A fact that has been criticized by students and staff, but resources simply have not permitted any other solution.

In most of these interdisciplinary course activities, music technology acts as glue (in the diagram above depicted as blue fuzzy balls), drawing different disciplines together. Only the MA, as a degree between Arts and Music, has a substantial amount of non-technology musical activities. Most other disciplines, such as Computer Science, Physics and Electronics & Electrical Engineering have a much higher demand for music technology courses, which can also result in a conflict of interests, described below.

A general tendency is currently evident of a nationwide decrease of students coming into the Electrical Engineering courses, and departments have problems of attracting students into their pure engineering degree courses. The more attractive courses seem to be Applied Engineering and similar degrees with a multi-disciplinary element, such as Multimedia, IT, Business Studies, and audio, video or music related courses. Within the University of Glasgow, for instance, the BEng + Music is a highly successful course which attracts a high number of students.

Engineering is one of the Departments with the largest research income, and with a relatively low undergraduate staff/student ratio: in effect the opposite of the Arts Faculty, with a high number of students but a low research income. The normal income gained from Under Graduate teaching in faculties such as Engineering cannot balance the cost of staff, and numbers have to be balanced across faculties which have a higher income from UG teaching, for instance the Arts. As the Arts Faculty itself has its own strategic plan concerning undergraduate expansions which might not include expansion of faculty-external degrees (as the BEng+Music), and similarly, as the Music Department is constantly in the position of needing to balance the demand for musicology, compositional activities and music technology activities, expansion into music technology cannot be done without considering the balance of sub-disciplines within Music and the balance of resources across departments within the Arts Faculty. Thus an expansion of, or building upon, the BEng degree can be difficult: although it would be logical from the Engineering Faculty's point of view, it is not of direct interest and might be contrary to the long-term strategic plans of the Arts Faculty, and possibly that of the Music Department itself.

This absence of the flexibility to expand into a successful area creates a deadlock situation in which Engineering Departments can only create their own interdisciplinary courses, not able to collaborate with other Departments dealing in this discipline. A big potential for teaching and research is missed.

The above problems can be seen to be reflected, with some negative consequences, within the Music Department at Glasgow University in the last few years. Consequences such as:

- inability to continue to offer the Music Technology Module for the Computing Science Dept.'s MScIT course
- inability to offer supervision for interdisciplinary projects between Computer Science and Music
- lack of expansion on the potential of the Physics + Music degree
- setting of restrictions in order to have a quota on Music Technology courses for MA and BMus, leaving fundamental computer-based music skills out of the current curriculum
- setting of a quota on BEng+Music intake and postgraduate supervision from Music
- non-willingness to fill new posts with academics in the music technology research field
- almost total disintegration of a once strong research area and a research team within the Department

As may be expected, this can lend a strained and tension-fraught environment to a highly attractive and in-demand discipline: causing general discontentment, and resulting in:

- Teaching staff leaving or taking early retirement, further aided by their skills and expertise being headhunted by industry companies
- Good technical and administrative staff feeling undervalued and unable to remain for long in these positions
- Students leaving within their 2nd and 3rd years
- Research not being able to flourish and being forced to keep a small profile
- General dissatisfaction in working and studying life reflected throughout departments

The potential in staff and resources in such an environment lies dormant: all this in an area which, in industry is the second largest in Britain, and which has one of the highest commercial, research and teaching potentials. For a discipline such as Music Technology to find itself in such a framework is detrimental to its own development as a discipline and undoubtedly detrimental to all those involved.

Only a very supportive Faculty or/and Department, might be able to compensate for the deficiencies that this type of structure in an institutional framework can create, generating a direct conflict of interests which seems difficult to be resolved.

3. The opportunities within institutional frameworks - Education and Research

Having covered some of the basic problematic issues of music technology within traditional HE institutional frameworks, one could attempt to formalise a range of possible solutions. To place a discipline, which has both creativity and technology as its central driving forces in a larger institution will probably provide a constant challenge. Larger institutional frameworks will always have the need for stable and permanent long-term structures in order to work efficiently, whereas creative disciplines, in general, stand opposed to institutionalised frameworks, and technology-driven disciplines tend to move too fast to stay efficiently stable for larger HE sectors. This has always been a problem, especially when it comes to equipment funding allocation.

Other institutions have tried solutions such as:

- the regrouping of disciplines to make faculties smaller and create smaller groupings of more similar disciplines. “Schools” seems to be fashionable these days, but the regrouping from faculties into schools can logically only be of benefit if the schools themselves replace the faculty structure, and not impose yet another layer of bureaucracy
- the creation of Music Faculties
- the creation of Centres of Study

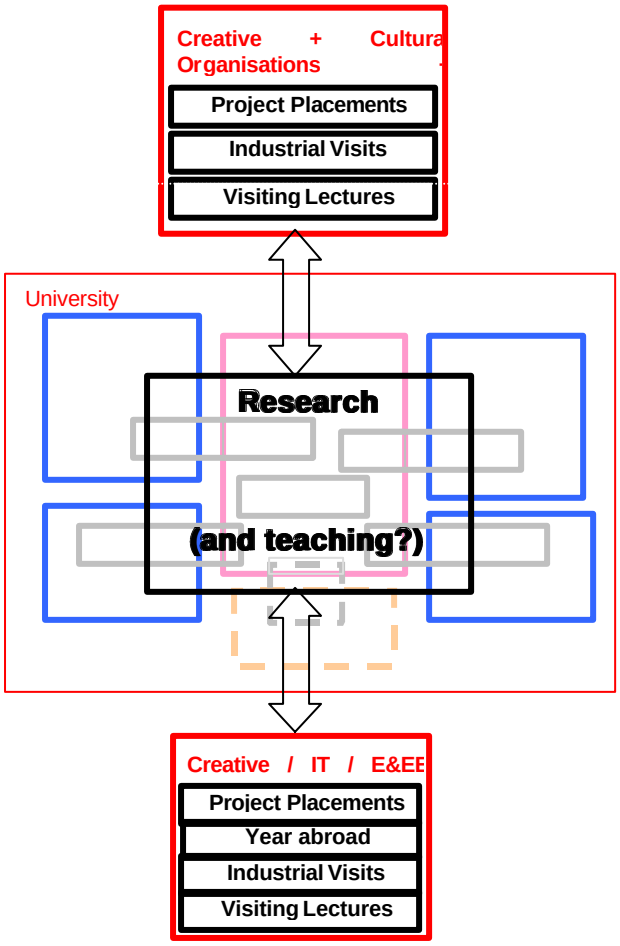


Fig. 5 Vertical Centres

The creation of centres is an interesting type of solution as it offers many possibilities that other frameworks are not able to supply:

- a centre might be made up of individuals from different departments with an interdisciplinary aim or objective
- a centre might include external organisations, such as companies and creative and cultural organisations, exploiting possibilities of project-placement, industrial visits, visiting lectures...
- a centre might interact with a number of departments and faculties with a higher level of independence and not restricted to departmental or faculty strategic plans.

"Vertical centres", or centres which include organisations outside of the university as well as different departments from within, offer many types of collaboration. Collaboration which not only provides a fantastic basis for developing the research field of music technology, but can also provide the overall need for formalisation of university-industry bridging, as emphasized by the EC in its newest 6th framework (See chapter 4.2.). Having adequate bridging is positive for students and staff in many areas of HE activities, but is vital for industry to exploit the newest developments in a field.

As there are more opportunities for research than teaching in our traditional HE framework, it becomes clear that there is a high importance placed on research feeding back into Undergraduate and Postgraduate teaching. In addition to this, in a fast moving field such as music technology, research becomes vital in order to stay close to state-of-the-art developments, as the status-quo is moving much faster than in traditional Arts/Humanities disciplines. This calls for a higher interaction between future technologies and the students’ curriculum. If centres are able to include teaching provision into their remit, then there is a higher amount and diversity of interaction between teaching and research, profiting the students in their acquiring of knowledge in this fast moving field.

Interactions of research and teaching can occur and can be supported in many ways and on many different scales:

- Assignments/Projects can be influenced or formulated by research/industry/external factors (see example below)
- Research Projects, PhD students and research staff can feed into the curriculum
- Industry/Organisation student placements in summer or for final year projects
- Industry/Organisation/individual visiting for lectures in a specific topic
- Larger student projects based on collaboration with external organisations/industry bodies
- etc.

3.1. Music Technology Education in Practice

To demonstrate interaction between research and teaching some examples from the BEng + Music course at Glasgow University are described. Below can be seen a schematic diagram of the BEng + Music and the MEng + Music degree programme at the University of Glasgow. This course is taught in both the Music Department and the Electrical Engineering Department. The Courses in Engineering encompass traditional electrical engineering subjects[9]. The courses within the Music Department encompass music technology subjects as well as non-technical music options, such as performance, music history and integrated musicianship.

In the first year, "Music and Technology" gives a good overview over the whole subject, introducing this area to students and training them in the basic tools for their further study. This includes sequencing, digital editing and music notation, but also covers repertoire of electro-acoustic music, basic HCI, software evaluation methods and other relevant aspects. "Acoustics and Studio Technology" provides a basic grounding and good general coverage in Acoustics, without going into depth in any specific area. The 20 hours of lectures and practicals cover aspects of room/concert hall acoustics, instrumental acoustics, sound production and wave theory, hearing, psychoacoustics, tuning and temperament, etc. This is followed by a basic Studio Technology course, building upon the acoustics knowledge gained. In this, the students are able to apply their knowledge of instrumental acoustics with new knowledge of microphones and placement, editing collages with recorded analogue sounds, acquiring basic knowledge of studio equipment, such as effects, multi-tracking, recordable media, etc.

In year two, this knowledge is deepened by "Practical Recording and Midi Processing", which is basically a more advanced studio technology course. At this stage students are required to record live concerts and produce session recordings, besides acquiring knowledge of the design and the use of state-of-the-art studio

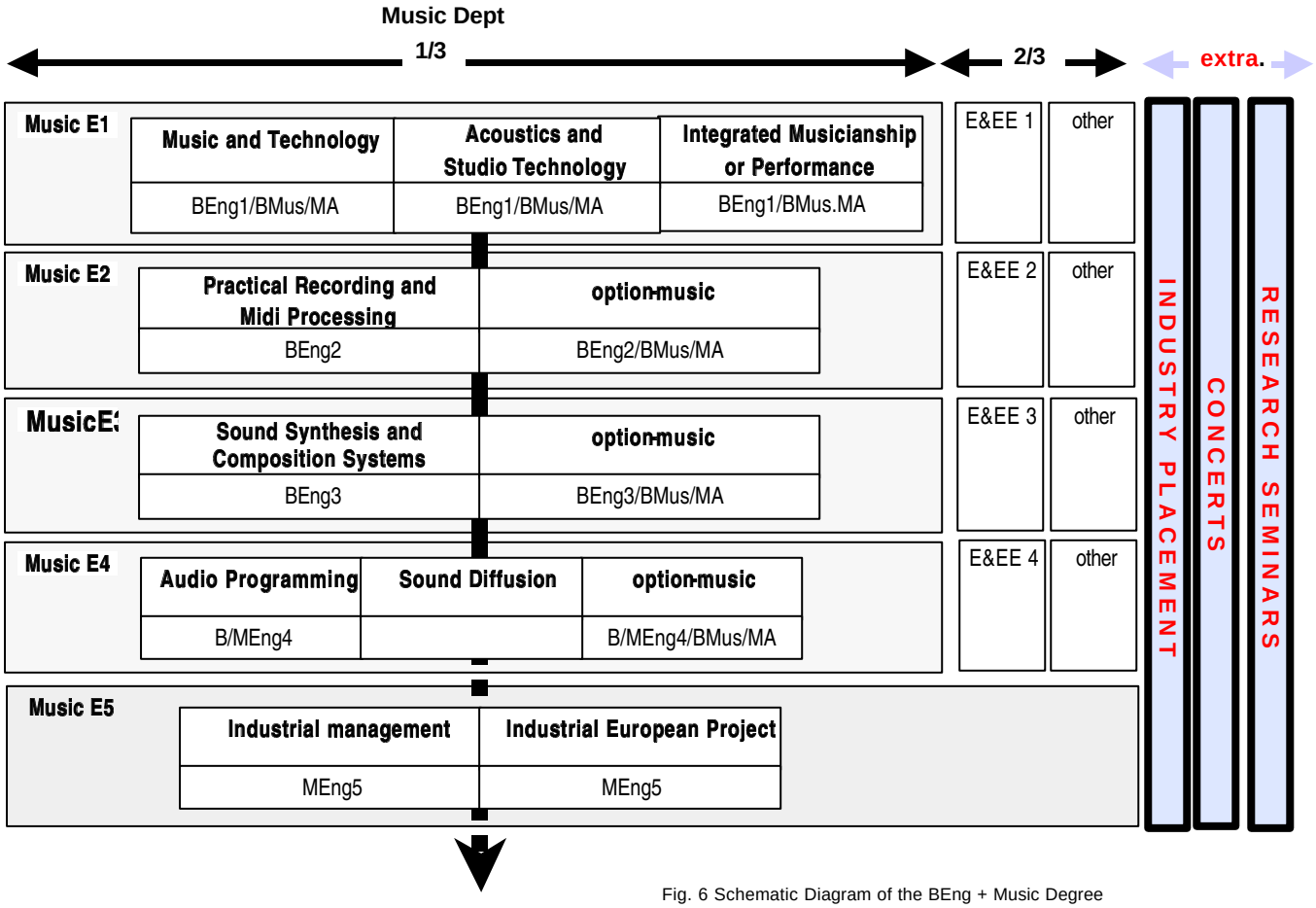


Fig. 6 Schematic Diagram of the BEng + Music Degree

[9] E&EE1 (EE1, Math1) , E&EE2 (Digital Systems, Electrical Circuits, Electronics, Design Project, Mathematics, Programming), E&EE3 (Communication Systems, Electromagnetics, Circuit Design, System Design, Mathematics, Team Design, Project, Real Time Computer Systems), E&EE4 (Final Year Project, Acoustics other courses)

equipment.

In year three, "Sound Synthesis and Composition Systems" enables the involvement with synthesis techniques using Csound and PD and other compositional tools. In the fourth year, a deeper understanding of spatialization theory and techniques, using works from "SSCS", is acquired in "Sound Diffusion" and "Audio Programming" allowing students to acquire high- to low-level programming skills for audio applications in C and C++.

MEng students continue on into a 5th year, which includes Business Studies and a placement abroad at a European institution or company placement. For MEng + Music students, the placements are music-technology related, such as placements at IRCAM in Paris, Sony in the UK, and so on. Supervision is shared between the Departments and the placement institution.

Throughout their fifth year extra-curricula activities are encouraged but not officially supported or required. The amount of which depends on individual staff input as well as the interest of students. These can include summer placements in music relevant industry or organisations, visiting regular concerts at the University, taking part in recording projects by staff or other students, attending research seminars, or becoming active in continuing projects, music groups, or clubs related to this field, such as student radio or television station, Big Band, orchestra or choir.

Only small changes were needed in the past few years, such as switching "AP" and "SSCS" in their respective years, or, as planned in the new year, to put MT and AST into one larger course together (starting 2001). In general, the curriculum is thought of, by students and staff, as highly relevant to their future job prospects. It is a highly successful and attractive course, with more students wanting to come onto this course than can presently be accepted. Staff teaching on this course has established a tradition of having a close relationship between research and teaching. In the past, when the course was co-ordinated by Dr. Stephen Arnold, courses such as "Music Technology" offered a modular approach that could allow newer technologies to be integrated slowly but continuously. Thus, in 1998 for the first time there was a three-week module on music databases, including database design and web-gateways for databases. A relevant issue as music has very special needs in terms of its information management. This module had a large input from the simultaneously-running SmaTBaM projects, which investigated systems for storing musical data.

Another example of a common-use external project becoming part of curricula activities can be found in one of our compositional modules. Dr. Nick Fells, having organised a electro-acoustic-visual-media concert in 2000, planned its dates to coincide with workshops of his compositional courses, thus being able to let the composers participate in the workshops heightening the awareness and understanding of such pieces of work for students, and enabling relevant feedback to be exchanged by students and composers.

For a more detailed example of a 1st year and a 3rd or 4th year course, "MT" and "SSCS" are again used. Between November 1999 and August 2000, a project was underway within the Music Department called "Direct software evaluation of Music Notation Packages for an Academic Context". This was funded by JISC/ JTAP/ UCISA, and evaluated music notation software packages on the basis of multi-user, multi-platform, multi-computer, networked system context [10]. In short, this evaluation considered aspects which are specifically relevant to educational institutions, especially in the HE sector, when considering what notation package to chose. The project was scheduled so that planned workshops and questionnaires for music notation users would fall into the 2nd term of the "Music & Technology" course, allowing a four-week module within this course to be used to

- cover basic issues around human computer interaction and evaluation techniques
- train basic skills in using different kinds of notation packages
- integrate into the coursework the music notation workshop with questionnaires of 1st time users as well as intermediate users

After the 4-week module, the students were given the project assignment (See Fig. 7, reduction from four page project and task description):

Class Project 1: Computer Based Notation Packages (Evaluation of music specific software, Notation)

The Scenario

Imagine you are a technical consultant hired to evaluate different notation packages. Your client is a Music Department in which 25 computers, which will be available for students and staff, have to be equipped with notation packages. These notation packages will be used for

- notation of composition classes and other music students in need of professionally looking scores
- training of the use of notation packages for the music industry
- professional creation of editions of Scottish music within funded departmental projects teaching, learning and training of the engineering aspects of developing music systems

Fig. 7 Excerpt of a Project Assignment within the MT course

Not only were students able to acquire knowledge in HCI and evaluation techniques for music software (which has its own specific needs), but also the results of the workshops with students fed-back into the Evaluation project, bringing direct benefit to both staff

[10] For more details on this project see Carola Boehm, Pauline Donachy, "Direct software evaluation of Music Notation Packages for an Academic Context" http://www.music.arts.gla.ac.uk/projects/NotationEval/ Last accessed 15/06/01.

and students with this high interaction between research projects and educational module.

A further example (of many) is the second project of the "Software Synthesis and Composition Systems Course", which is basically a synthesis problem solving project. This project was assigned for the first time in 1999. The idea for this project came from a group of research projects running in the Computer Science Department under the co-ordination of Dr. Stephen Brewster. This group, which has had a long background in sonification of interfaces, had started on the creation of a standard set of guidelines for the creation of sonificated interfaces[11]. These guidelines have been further applied to in one of their projects by designing a talk-mail service using musical melodies to signify status of the user's location run in collaboration with IBM.[12]

Within the Sound Synthesis class, the opportunity arose to apply both aspects of this projects to a synthesis problem solving projects (See Fig. 8):

Class Project 2: Software Synthesis and Composition Systems
(Synthesis Problem Solving - IBM Call Centre)
The Scenario

Imagine you are the person responsible for designing the sonic environment for a telephone talkmail service. This sonic environment includes discrete sounds as well as continuous sounds, all having to convey certain navigational or user-interface functionality.

The service is structured hierarchically, through which the user navigates via pressing buttons on a telephone. Thus he/she has no visual information, any information about the status of her/his position is purely through voiced and sonic information. Your client, or the producer of this talkmail service, wants to add audible cues and sounds to convey

- the navigational status
- the status of an event (i.e. is there much to rewind, how many more messages are there to be played, how many messages are there to be received.
- events in case of errors or misuse

Fig. 8 Excerpt of a Project Assignment within the SSCS course

Using the guidelines developed by the HCI group from Computer Science, the students created sonified interfaces using sound synthesis techniques. Thus the assignments and the comments of the process within the project reports, were used as first feedback for using the guidelines to create sonified interfaces. On another level, the single assignment outcomes fed back into the IBM project, by looking at the feasibility of using sound synthesis techniques to realize a sonified talk-mail service, apart from the melody-based interface which it was presently using.

In this way, the skills of the BEng + Music students in Sound Synthesis Techniques enhanced directly the project in Computer Science, which normally does not offer courses in sound synthesis techniques. In the same way, the existence of an IBM talk-mail project with a prototype interface available from the computer science department, including the guidelines, created a very interesting and industry relevant project for students. Feedback from this course demonstrated that the variety of projects, and specifically this project, was found to be not only interesting but fun, and that students thought of it to be highly relevant to their future careers.

3.2. Music Technology Research – Bridging the Gap between HE and industry

As mentioned above, research within HE institutions provides, to a high extent, the freedom within institutional practices that UG teaching cannot provide. Considering the potential of this subject, it would be in the interest of institutions to support such research, as it is highly commercial viable in many areas and means that industry-bridging should actually be very easy, although it is not often done. Research within music technology, can not only be applied to the second largest industry in Britain: record sales, but offers integration into the telecommunication industry, broadcasting industry, culture industry, the education industry and related areas such as film-making and other creative industries.

Although this potential is relatively obvious, there has been a problem of university-industry bridging in the past. Music technology research seems to have been channelled primarily into two directions:

- either music technology research outcomes, if coming from music departments, have traditionally been channelled mainly into the culture industry, into compositions and performances
- or music technology research outcomes, if coming from the engineering departments, has been channelled mainly into the telecommunications industry.

There seems to be a hurdle of transferring outcomes from academic research into industry: non-profit cul-

[11] Brewster, S.A., Wright, P.C. & Edwards, A.D.N. (1995). Experimentally derived guidelines for the creation of earcons. In Adjunct Proceedings of HCI'95, Huddersfield, UK
Guidelines for the creation of earcons, A. Walker, M. Crease, Stephen Brewster (DCS) http://www.dcs.gla.ac.uk/~stephen/earcon_guidelines.shtml Last accessed 15/06/01.

[12] Brewster, S.A., Leplatre, G. and Crease, M.G. (1998). Using Non-Speech Sounds in Mobile Computing Devices. In Johnson C. (Ed.) Proceedings of the First Workshop on Human Computer Interaction with Mobile Devices, (Glasgow, UK), Department of Computing Science, University of Glasgow, pp 26-29.
Leplatre, G., Brewster, S.A. (1998). An Investigation of Using Music to Provide Navigation Cues. In Proceedings of ICAD'98 (Glasgow, UK), British Computer Society. Adobe PDF
Leplatre, G. and Brewster, S.A. (2000). Designing Non-Speech Sounds to Support Navigation in Mobile Phone Menus. In Proceedings of ICAD2000 (Atlanta, USA), ICAD, pp 190-199.

tural or profit-based industry. Universities in general seem to be become more and more detached from industry, which has been noted and addressed by the European Funding Programs [13]. This gap is characterised by a surplus of technology, left without being integrated into products or systems. It follows that one of the main aims in the 6th framework of the EC is "technology integration" in order to "force" the needed university-industry bridging for technologies to become a societies' tools.

Within the music/audio industry, this can be said to be true, especially if comparing to the video/visual industry. This area seems to have bridged the gap from research to products much faster, for instance in animation/effects techniques, despite it being younger than the music industry.

Within music there are areas which tend to pick-up innovative technologies very fast, such as synthesiser technology, but these seem to be far and few if looking at the whole area of audio/music related industry.

3.1.1. Music Departments and industry collaboration

There is probably a number of interconnecting reasons for this gap between industry and research to occur, but one answer could be the location of music technology within frameworks which are not used to handling industry-bridging activities. As the visual/video technologies have traditionally been located within the computer science departments in Britain (and Europe), the developed technologies and research outcomes were well placed in a framework used to marketing their own results and providing the needed interaction between industry and university.

For music technology, the traditional positioning within music departments resulted in the developments of more artistic goals, not having the aim of commercialisation of technologies, nor having the experience or tradition of industry collaboration. For the cultural products this had a very beneficial effect, and one could say that music technology centres have created a large number of tools for composition which no other creative digital discipline can match in quantity, quality or diversity. Nevertheless, this also created some unnecessary gap between industry and university research.

Based on the above reasons, some centres have opted to be placed wholly or partly in the science departments (engineering or computer science), and have done so very successfully. But the ideal would be a centre "in the centre of these subjects", as the drive for technology innovation can only be supported in a major way by artistic creative considerations as well as industry-relevant ones.

[13] See documentation of the 5th and 6th EC Research Funding Frameworks

3.1.2. The Size of Music Technology Centres

The location of centres within smaller departments is another issue to consider. Smaller centres and smaller departments are often disadvantaged in large institutionalised frameworks, summarised through:

- not having a critical mass of research active staff
- not having a critical mass of administrative and technical support

Both of which have an adverse effect on music technology research, and some strategic decision will always be necessary in order to compensate the disadvantages that a small size may bring.

3.3. Strategic Considerations for Music Technology Research

The need for vertical centres which sit apart for the institutional departmental and faculty structure has been emphasised, and should be emphasised again considering the above factors of discipline, location and size. Horizontal Research Centres, which sit apart from departmental and faculty structure and include individuals and subjects fed from several different faculties and departments are one of the keys to success in a healthy research environment. Vertical Research Centres, which include outside organisations as well as the above Horizontal Research Centres, provide the added impetus for industry/organisation bridging activities.

For smaller centres to survive, and for medium-to-large centres to work efficiently, the following research strategies can help to support a healthy research active environment.

3.3.1. Low Administrative costs / application development

Administrative costs, such as budget control and monitoring, project reporting, etc. need to be kept as low as possible. Similarly, the efforts going into acquiring new funding through application development should ideally be minimum effort for maximum reward. Two aims to achieve that follow:

- <u>Aiming for longer and larger projects:</u>
  A logical objective for research active groups or individuals to reduce the amount of administrative effort and maximise on human resources is to apply for longer and bigger projects. This is sadly contrasted by the tendency of funding bodies to support a decreasing amount of long-term actions. Three-year R&D projects have become very rare, especially in areas of creativity, culture and education. Projects less than three years have the consequence that PhD students cannot be sought out for these projects and an influx of short-term contract research staff has become the norm. This, consequently, has its own problems.

Another upshot of shorter projects lies in the heavier burden of effort needed for application development. As the quantity of work is often the same for both shorter and longer projects, shorter projects are disadvantaged considering aspects of searching for, contracting-in and training new staff, and also considering administering costs related to the project and providing technical and administrative support.

The benefits of being able to run one or even several long-term projects is high, with a constant and stable research environment not too over-burdened with the continuous pressure of acquiring new funds and staff through project application development.

- Interconnect with working groups to access funding for networking:
  Funded working groups have several advantages which may not be immediately obvious. The main funding available for working groups is for travel and subsistence, meetings and working conferences/workshops and the administration of this, i.e. networking.

  This networking is vital for developing new projects with a minimal application development effort. Although it may seem strange to use visits to a workshop with a specific deliverable as a platform for meeting prospective future project partners and working out the funding application details at the meeting, it is in generally seen to be rather good practice by funding bodies and a very efficient use of their money.

  As most funding bodies today are stormed with interdisciplinary project applications it can be difficult for them to see a whole picture of development emerging, as single applications might represent a small puzzle-piece from a large puzzle with many gaps still to be filled. Funding bodies tend to avoid duplicating their efforts as they do not want to fund research twice. In general, they know that competition within one funding body's remit should be avoided and that collaboration should be supported.

  Thus, it is in their interest to have communication platforms that will enable more collaborative applications to take form; resulting in having less project applications with more participants of an expert field, and less similar project applications incorporating more input fromexpert individuals.

  Besides the benefit of working groups providing a platform for application development, they also have the advantage of being seen in an advisory capacity to funding bodies, as well as other parties in decision making levels. This implies that the participation of working groups closes the circle of:

  First) being within a community of active researchers,
  Second) applying for funding from funding bodies who create themes and calls to support specific-needed research,
  Third) and providing the knowledge back to funding bodies regarding research that is needed and required.

  One last small, but crucial, benefit that working groups have is their role as dissemination platforms. In these forums, already completed research can be disseminated and/or taken up by partners of working groups, and quite often this canbuild the basis upon which working group themes are built.

3.3.2. "Soft Funding" and "Hard Funding"

"Hard funding" in this terminology can be defined as funding bound to tasks, specific resources and deliverables. A large part of funding for research and development projects falls under this category, as within application processes, deliverables and outcomes that have to be specified to a more or less specific degree.

"Soft funding" is generally much more difficult to acquire, as it often needs long-term collaboration of industry and research organisations. Sponsorships through funding of equipment, benefactors, or similar funding may not be bound to specific outcomes or deliverables. In order to acquire such funding an often non-explicit understanding between sponsors and beneficiaries of the overall positive influence that this specific area of research can provide needs to be in place. This positive influence can be in form of:

- graduates knowing the skills required of a sponsor' s industry
- teaching and research profiting from sponsorship and provision of professional equipment specific to certain sectors of industry
- support of continued staff and student placement schemes, allowing the bridging of knowledge and experience between industry and university

In general, it is much harder to acquire this kind of soft funding as it is often a non-competitive process of establishing long-term relationships between academic departments and industry. Again, science departments have long been used to processes that can acquire soft funding. Arts-based departments, traditionally, have not. Music Technology Centres have the potential to develop "soft funding", however in the case of the University of Glasgow's Centre for Music Technology for instance, such potential has not been exploited at all.

3.3.3. "Enabling technologies" and "Technology integration"

Although it might sometimes be hard to differentiate enabling or basic technologies from the technologies built on top of them, in general it can be highly efficient to specify research projects based on results of former projects. This is seen positively by funding bodies, as well as pushing the research results forward in a fast and efficient manner.

For centres running several projects concurrently it is of advantage to keep a healthy ratio of projects developing enabling technologies and projects with technology integration, thus creating new and exploiting mature technologies simultaneously. Although this may seem obvious, keeping a watchful eye on the ratio of enabling technology projects to technology integration projects can help discover new research opportunities. (See also 3.4 and Fig 9 for an example of this)

3.3.4. The new "funding diversity" for Music Technology

There is a new funding diversity for music technology. Most of the science-based as well as the arts-based funding councils accept some or the majority of music technology research as valid research, and allow it to be funded within its own remit. Although there is a danger of interdisciplinary subjects "falling between chairs", usually interdisciplinary centres can exploit this diversity more than uni-disciplinary ones. Some of these funding bodies, as described in more detail below, even address specific themes around the area of music technology, such as "creative pull", "creative productions" and "music technology".

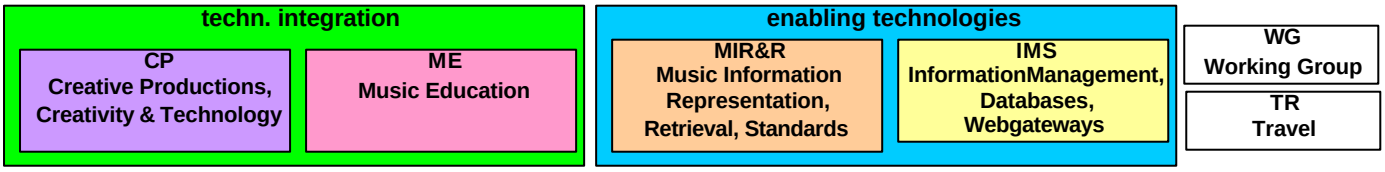
3.4. Music Technology Research in Practice - an example

An example for the tight integration of technology enabling and technology integrating projects can be seen in the list below (Fig.9). This listing highlights a selection of projects that I and the Centre for Music technology have been involved over the last five years. Colour coding further emphasises the close integration of the interrelationship of the projects.

In general the research groups have four major research themes:

- **IMS** - Information Management Systems for Music and time-based Media
- **MIR&R** - Music Information Retrieval and Representation, Standards
- **ME** - Music Education, including Web based teaching of music, using ICT for music education
- **CP** - Creative Productions, creative pull applications, creativity and technology

With this list, one can easily point out all projects running in one field of research, as for instance PADS, SMaTBaM, PADS/SMIC all being within Music Infor-



Name	Funding Body	End date	Amount accrued to Dept	Totale Amount	Principal Investigator	Role	Field	enabl. & intgr. Tech.
OpenDrama	EU	2004	£199,000.0(	£1,248,735.8(	Italy	PI@Institution	CP	TI
MuProNet	EPSRC	2004	n/a	£58,811.0(	London	PI@Institution	MIR&R	WG
MusicWeb Connect	EU	2001	£12,000.0(	£100,000.0(	Den Haag	PI@Institution	ME	TI
MuTaTeD'll	Re:Source	2001	£35,000.0(	£35,000.0(	Carola Boehm	PI	MIR&R	ET
CIRCUS	EU	2001	£30,000.0(	£2,000,000.0(	Working Group	PI@Institution	CP	WG
Revelation		2001	£0.00	£665,000.0(	M. Atkinson	on Mngmnt. Group	CP	TI
PADS	JISC	-	n/a		Stephen Arnold	RA/Databases	IMS	TI
Notation Evaluation	JISC/UCISA	2000	£9,000.00	£9,000.00	Carola Boehm	PI	ME	TI
Artism LtD	Consultancy	2000	£27,000.0(	£27,000.0(	Carola Boehm	Consultant	IMS	TI
Travel Grant RSE	Royal S. Eng	2000	£600.00	£600.00	Don MacLellan	PI for travel	MIR&R	TR
MPEG7	John Robertson	1999	£1,500.00	£1,500.00	Carola Boehm	PI	MIR&R	TR
Mutated1	JISC	1999	£9,000.00	£9,000.00	Carola Boehm	PI	MIR&R	ET
MusicWeb Hannover	Niedersachsen	1998	£20,000.0(	£20,000.0(	Hanover	Programmer	ME	TI
PADS/SMIC	SCRAN	1998	n/a		Stephen Arnold	RA/Databases	IMS	TI
PADS/Imagination	BUFVC, BFI	1998	£9,200.00	£9,200.00	Stephen Arnold	RA/Databases	IMS	TI
SMatBAM	SHEFC	1997	£32,000.0(	£32,000.0(	Stephen Arnold	RA/Databases	IMS	ET
MusicWeb Den Haag	Netherlands	1996	£25,000.0(	£25,000.0(	Den Haag	Programmer	ME	ET
COMES	Germany	1995	n/a		Germany	RA/Programmer	MIR&R	ET

Fig. 9 Tight integration of enabling and integrating projects

mation Management (IMS) or MPEG7, MuTaTeD'II and MuProNet all being within Music Information Representation & Retrieval (MIR&R).

In the last column, TI and ET signifies "enabling technologies" and "technology integration", whereas TR specifies any travel grants, WG any Working groups.

It can also be seen from the arrows how these projects built up onto each other, the first MusicWeb Den Haag project specified the basic technologies needed for a development of a music educational system, and all consecutive (but individually funded and co-ordinated) projects of MusicWeb, such as MusicWebHannover and MusicWebConnect built upon this first project. Similarly, SmaTBaM built a prototype system for serving massive and a critical mass of time-based media over wide-area-networks, and PADS used this prototype system to set up its digital library service.

4. The New Funding Diversity for Music Technology in Britain

During the last six months there have been a number of workshops organised by funding bodies and funding councils with the goal of acquiring feedback from the research community about the needs and requirements for funding within specific areas. These workshops provided valuable information about where the funding bodies are moving, and how the funding tools will be changing according to the changing face of economic, industrial and educational factors. Two of these workshops are used as example to demonstrate the changing face of funding for music technology within Britain and Europe.

Using EPSRC and the EC as the sole examples obviously means omitting one of the major funding councils for the creative activities, the Arts and Humanities Research Board. It, in itself, has not been in existence for very long and thus does not have the need to redefine its remit. The AHRB was set up to specifically cater for the needs of creative, cultural and humanities-relevant research. To the author's knowledge, no research community workshop has been organised, however the fact that the AHRB is the funding council closest in its remit to creative, performative and compositional research activities within music technology, makes it the most widely known: at least within the creative and artistic user communities. Although issues surrounding the positioning of technology-development within creative projects are unspecified within the AHRB and easily discarded as being within the remit of more science-based funding councils, the AHRB has shown an immense interest in supporting creative productions, with or without a technological basis.

4.1. EPSRC - Engineering and Physical Sciences Research Council

EPSRC is the Engineering and Physical Sciences Research Council, and it is the largest of the seven Research Councils within Britain. In February 2001 it held a two day workshop on the "Funding of Music Technology within EPSRC" (Harrogate, Feb. 2001)[14]. Fifty individuals from various academic institutions were invited, representing an attempt to have experts covering most areas within music technology.

Nigel Birch, who co-ordinated the workshop as a representative of EPSRC, mentioned in his introductory talk the problems which a funding body such as EPSRC presently faces:

- a rising number of music technology funding applications, representing few and small pieces of a large puzzle
- growing problems of bridging universities and industry (and marketing)
- a lack of enough projects with the emphasis on technology integration, resulting in a surplus of technologies which are not utilised by industry or are not distributed to user communities

With these problems in mind the workshop concentrated on the following aims:

- to map the discipline of music technology (from the ESPRC point of view)
- to identify enabling technologies and secondary technologies
- to identify priority research areas
- to identify capable funding tools

The results of this workshop were extremely interesting. A detailed "knowledge map" of the research field of music technology was provided, which, unlike existing taxonomies, concentrated on the development of technologies as a starting point. This allowed a good overview of the research scope, and the addition of specifying primary and secondary technologies (enabling technologies and technologies based on enabling technologies) resulted in realising priority areas as well as research "holes" in which technology outcomes are missing: hindering further progress in a specific research area.

For EPSRC this contextual map of priority areas is meant to have a sort of "roadmap" effect for further funding strategies.

One of the direct results of this workshop was that EPSRC will allow the development of technology based

[14] See EPSRC REPORT: Music and IT. Engineering and Physical Sciences Research Council, IT and Computer Science Programmes: Music and IT, The Report of a Workshop held at the White Hart Conference Centre, Harrogate on 20/21 Feburary, 2001.

on creativity support as a valid research activity within their funding remit, as long as technology development makes up 51% of the overall activity. Also, the notion of accepting the potential in experimental approaches (serendipity, accidental inventions, exploratory approaches, basic research) was also accepted and will be supported by EPSRC in the future.

The notion of creative pull was mentioned in that "the use of technology by artists can push the technology development"[15]. Other conclusions, amogst many others were: the need to integrate or support the integration the research community into the formation of standards, outcomes of research should be evaluated on artistic as well as technical merit, specific areas of interdisciplinarity need development and support in their collaborative efforts (ex.: cognitive sciences and music, social sciences and music technology, etc), language barriers between scientists and artists still need to be overcome, etc.

In terms of funding tools, it was announced that traditional project funding would be continued, but supported by "Networks of Excellence". These networks would be of a distributed nature, unlike the French model of centralised physically located centres of excellence. Support would be in the form of administration, travel, working group meetings and events.

4.2. The European Commission

Similar to the EPSRC meeting, the European Commission invited to a workshop at the FhG Darmstadt in May 2001 called: "Technology platforms for cultural and artistic creative expression". In its inviting letters the commission stated that:

> *"The discussions will be used to help us establish future priorities in this area, which could be supported within the framework of our IST Programme as part of a new Cross Programme Action (CPA) to be introduced in the IST Work Programme of 2002."*[16]

Representatives presented the problems in which the EC find itself, which, although within a more general remit of creativity and cultural activities, are similar in nature to EPSRC.

The last two funding frameworks (4th and 5th framework) resulted in a surplus of technologies which have not been integrated into industry or distributed to the user of the "information society", as specified in the current framework. This surplus of technology is generally seen as an unexploited resource, and its integration needs to be supported, specifically within the SME industries.

Another problematic area is that the last, fifth, framework found itself swamped by projects concentrating on art preservation, and although the calls specified cultural and artistically creative productions, most applications and successful projects were of a preservative and archiving nature. The EC sees this as a potential hazard meaning that, at some point, no new works of art - specifically digital art - will be created, making technology innovation solely for the purpose of preservation of traditional art and cultural objects.

Within these two major problems the workshop aim was set to:

- Survey existing activities + identify major technology shortcomings
- Identify key issues to be addressed within 5 to 10 years from now
- Identify key players and, if needed, the additional actors
- Develop a strategy for the articulation of such an action with respect to the 6th Framework Programme, currently in preparation

The one-day workshop formulated on that day surprisingly refreshing results for creative & technology research:

- Creative Productions will be emphasised and part of Framework 6
- Acceptance of the concept of Creative Pull (see next chapter)
- Emphasis on Generic platform for creative processes, available to a wider user community

Nevertheless this refreshing attitude is only partly reflected in the official report[17] with a lot of un-useful and too general and trivial statements (such as "audio should not be forgotten…", "emphasis on natural interfaces…", "content is key…", "focus on end user…", etc) and only some useful conclusive recommendations. Amongst them are that:

- technology needs to be resistant in time and space in order for artist to take them up in a critical mass
- the access threshold of artists into R&D projects should be lowered
- importance of proper education and training in this area was stressed
- danger of EU projects being to market oriented
- standards involvement of the artistic and cultural community

[15] See EPSRC REPORT: Music and IT, p.1.

[16] Letter of invitation to the workshop at the FhG Darmstadt in May 2001 called: "Technology platforms for cultural and artistic creative expression"

[17] DG2, DG3, EC, Meeting Report – Workshop on Technology platforms for cultural and artistic creative expression, 21-22 May 2001, Darmstadt, Germany, http://www.cordis.lu/ist/ka4/vision/Darmstadt-conclusdions.htm. Last accessed 05/10/2001.

Considering funding tools, the stress on medium-to-long-term exploratory action was mentioned, as was emphasised the creation of networking centres of excellence, and prioritisation of integrative projects with a large amount of technology integration.

This one day workshop, although very interesting, did have some, form the CIRCUS point of view (see below in next section), questionable outcomes, which seems to demonstrate a still lingering tendency towards technology push instead of creative pull as in the workshop "some argued that a technology push is needed since traditional techniques will not provide enough motivation to innovate" and that "creative work and deliverables/milestones do not go well go together - But it was felt that the artist community can also respect deadlines"[18]

Although the apprehension of some towards these results, it was understood by all that this meeting represented only a first attempt to begin to understand, thus this report was to be understood only as an initiating of a process rather than final recommendations. in general the continued discussions of the integration of the creative-pull aspects of project development was accepted, how it will be supported within new funding frameworks still leaves to be looked at.

For areas such as music technology, in which serendipity, creative and exploratory approaches may lead to something new and innovative, the acceptance of "creative pull" processes is a "sigh of relief" regarding having to phrase project proposals with outcomes already known: a notion going against many kind of approaches for basic research as well as creative processes. The support for networks of excellence again implies support for individual creative users which, until now, were not able to participate within research projects as they were not bound to academic institutions. This left a large creative potential unexplored. The notion of acceptance of creative pull (further described in the next section) will free the creative user or artist from the role of service-provider to that of an individual whose expertise needs to be involved form the design to the implementation stage.

4.3. CIRCUS working group - Content Integrated Research into Creative User Systems

CIRCUS is a working group funded under the last calls of the fourth framework of the European commission. It started in October 1998 and will run until October 2001, in the last weeks of which a conference on the issues of creativity and technology will be held in Glasgow.

Its aim is to advise the EC on the integration of content and technology in terms of creative pull vs technology push. It aimed to gain a fuller understanding of the relationships between content, medium and technology in user contexts ranging from data creators to data users, from entertainment through education to fundamental research.

This group of ca 50 active individuals, representing ca 16 different European institutions involved in creative productions, including artists, film-makers, designers, musicians, composers and authors, has identified major issues and problems which will need to be addressed by the next funding frameworks in order to exploit the potential of creative production to the fullest.

In the centre of these problems stands the challenge of content, medium and technology: the needed balance of "Creative Pull" vs "Technology Push". The concept of creative pull has more complex implications of

- integrating the creative user from the start of a application developing process, instead or attaching him as a service or as an end user
- providing frameworks for letting the interaction between creativity and the development of technology happen throughout all phases of project development
- providing production methodologies or business models to cope with situation in which creativity pulls the development of technology along with the inherent dilemma best described as "building the camera while making the film"[19]
- providing the framework in which individuals artists can participate in research projects, without the need of their belonging to an academic institutions.

CIRCUS has found that some of the detrimental effects of the lack of creativity pull within digital art can be seen in the fact that 90% of artists are still using traditional tools. In addition to that, production from digital tools seems not to support creative processes, but rather to provide a template way of thinking and producing: more appropriate for mass production than works of individual art. Within our current creative environment of digital art production artists, surprisingly, still manage to be creative, but it is the opinion of CIRCUS that this is not because of the tools but <u>despite</u> the tools.

Issues which need to be addressed before this situation can change are:

- The lack of integration of the creative user with creativity seen as a service, to be able to be brought in, rather than integrated into, a process
- Current Systems have not proven to be adequately permanent. Digital Art needs to be resistance in time and space, for at least 20 years in order to be considered for use by the critical mass of artists.
- There needs to be a balance between funding Art Creation (Tools development) and Art Preservation/Consumption

[18] ibidem

[19] Phrase coined by Dr. John Patterson, University of Glasgow, in the beginning of the CIRCUS working group, 1998.

- There needs to be support for style development, (Manner, Expression) and similar processes in digital creative productions

Within these main points, CIRCUS has published a list of its research themes that can be used as a more or less comprehensive list (Fig.10) of issues needing to be addressed by future research. These include:

DESCRIPTION OF CULTURE: ARCHITECTURES OF INFORMATION
- Metadata for creative use contexts
- Cultural and Connectionist Metadata
- Standards supporting creativity
- Open standards in creative use contexts
- Data Structures for digital creative production systems
- Style, Manner, Expression and processes in digital creative productions

THEORY AND METHODOLOGY OF DIGITAL CREATIVE PRODUCTION CONTEXTS
- Theory relevant to practice
- Best Practice examples
- Strategic Citing of experimental work

INTERACTIVITY AND THE FUTURE OF THE CREATIVE PRACTICE
- Technology Push - Creative Pull Applications
- User interfaces and interfaces extensions to support creative processes
- Creative empowerment - applications supporting style development and style
- Best practice in education for creative users
- Experimental interactive creative environments
- Taxonomies of interactivity

INSTITUTIONAL SUPPORT FOR INNOVATION OR CREATIVE PULL
- Implications for Education and Training
- Production methodologies for the creative industries
- Vertical Markets in the Creative Industries
- Business Models supporting creative processes
- Methodology for reflexivity within interdisciplinary practice

Fig. 10 CIRCUS Synergy Themes and Subthemes

5. Conclusion

This report has attempted to provide an overview of the current opportunities and challenges with which the discipline of music technology within Higher Education Institutions is faced.

The experience with other working groups in a broader area has provided the insights to confirm that the challenges and opportunities described and stated in this paper are not specific to Music Technology, but could and possibly should be tried against other interdisciplinary technology based subject areas within the "digital arts". It may seem that Music Technology is a prime example for the opportunities and challenges faced in Higher Education today, not only because the authors background is within this area, but also because Music Technology has a longer history and a more established place within institutional frameworks today. For decades a community and culture has already been formed, and we can already distiuinguish the consequences of outside forces, such as funding or educational structures, within this community and its culture. From a more general perspective, these insights should be able to be used to compare and discuss the integration of the other "digital arts" within the HE sector.

More specifically for Music Technology, we are still in an era where due to its interdisciplinary nature, its integration within institutions with discipline-specific structures is still undoubtedly difficult, especially in UG and PG teaching. But there are opportunities:

- Institutional Frameworks still offer a challenge for teaching of interdisciplinary disciplines such as music technology
- Most opportunities lie in research, and these opportunities are growing in number and diversity
- Research can be used to improve teaching

As demonstrated, although it is one of the newest fields to be adapted for teaching within the HE sector, the potential for music technology is immense, and the need for graduates as well as researchers is predicted to rise.

Within a research this potential can be exploited to the fullest if one keeps a remit of
- continuing to provide a basis, through standards involvement, working groups and development of enabling technologies
- supporting the integration of existing and mature technologies, through having the courage to built bigger systems, utilizing a diversity of technologies
- supporting creative processes and balancing technology push with creative pull

A final solution for a successful framework structure within our present HE institutions and addressing most problems mentioned in this report lies within the formulated "Vertical Centres for Teaching and Research", lying detached from the discipline-specific departments or faculties, they can draw on the expertise held within various internal and external organisations and different fields, and can build upon the interaction of these disciplines to create a successful and highly promising future for music technology research and study.

MusicWeb Connect: A European Project for creating web-based Tools and Resources for Music Education

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Abstract

With the cornucopia of online education packages appearing on the web, Glasgow University in collaboration with the Royal Conservatory of Den Haag is again at the forefront of a collaborative project to create and to facilitate the production of music education resources. As with Netmuse, which was a previous collaborative project of Scottish music departments utilizing high performance networks (ATM) and creating university level musical educational resources, the Centre for Music Technology is co-ordinating the technical side of another internet / intranet-based project, MusicWeb Connect, in collaboration with five other European institution.

1. Who is MusicWeb?

The MusicWeb consortium of c. 15 partners has been in existence since 1995, with its main focus being to enable the creation and development of music-educational materials and to make music education and learning via the web a primarily musical experience. The MusicWeb project is currently funded through a 14-month funding venture by the European Commission through the CONNECT programme, and is supported by Naxos music publishers.

The members of the MusicWeb CONNECT consortium are:

- The *Royal Conservatory of Den Haag*, which is responsible for the management and coordination of the project. Den Haag has so far developed educational applications and authoring tools, and set up and maintained the central multimedia server.
- The Centre for Music Technology, *University of Glasgow*, which coordinates the technical side of the project. Existing servers are linked to the central server in Den Haag, and together with the IICM Graz, Glasgow University is adapting existing products for learning technologies (Hyperwave information server and GENTLE web based training environment, both developed by the IICM) to the MusicWeb environment. In addition, together with Darmstadt University, technologies regarding structured music (SMDL-MuTaTED and GUIDO) will be integrated. Glasgow is also coordinating the evaluation and dissemination of the project results.
- The *Hanover University for Music and Drama* (Hochschule für Musik und Theater Hannover) has developed content material specifically for use by young students and children in primary and secondary education.
- The *IRCAM Research Institute* in Paris (Institut de Recherche et Coordination Acoustique / Musique) is one of the world's largest institutes devoted to musical creation with new technologies, developing software for music composition and multimedia tools for education. IRCAM has contributed educational materials on twentieth century contemporary music.
- The *IICM Institute* in Graz (Institute for Information Processing and Computer Supported New Media) has developed the Hyperwave information server and the GENTLE web-based training environment, which are the core of the MusicWeb structure. Together with Glasgow University, the IICM is adapting their products to the MusicWeb environment.
- The *Technical University of Darmstadt* is concerned with the integration of their GUIDO music representation language within the MusicWeb environment. Together with Glasgow University, they are integrating technologies regarding structured music (SMDL-MuTaTED) and their connection to GUIDO.

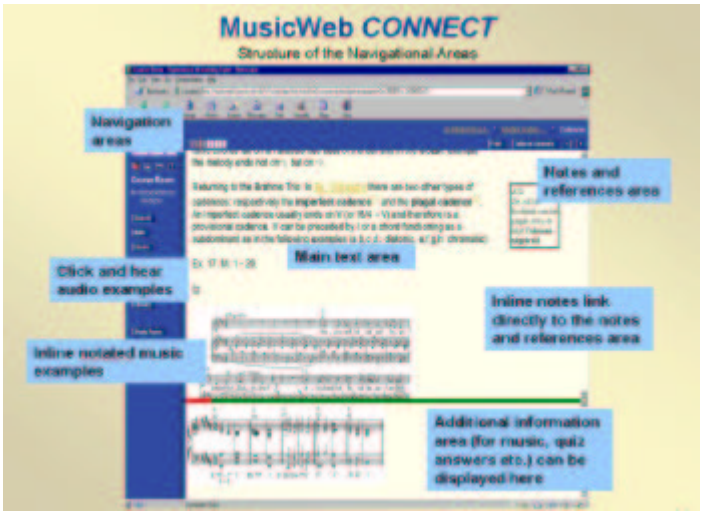
MusicWeb is open to those who decide to join the MusicWeb group and use the music education resources and skills therein, or who want to use the authoring tools and facilities provided by MusicWeb to add to and enhance current materials with their own tools, specialist skills and music education modules.

2. What is Music Web?

The MusicWeb group has created the tools to enable anyone, as a member of MusicWeb, to access these weblications, and to facilitate the creation of new modules with maximum ease.

The music-education resources and materials made available through the MusicWeb project are designed in a modular and highly flexible way to assist their integration into a wide variety of music courses and independent-learning scenarios.

More common features found within educational web-based applications are present within the MusicWeb System, such as password restricted access, discussion forums, progress tracking, version control, conferencing support, WYSIWYG editors, etc. Moreover, the consortium has provided tools for the specific needs of music education, unlocking the specialist skills and resources available within individual institutions so that they can be exploited to the general educational benefit of the music community at large. This means that the varying pedagogical approaches and characteristics of the courses offered by individual institutions can be maintained and preserved while utilising the resources



and materials and creating their own courses and modules within the MusicWeb framework.

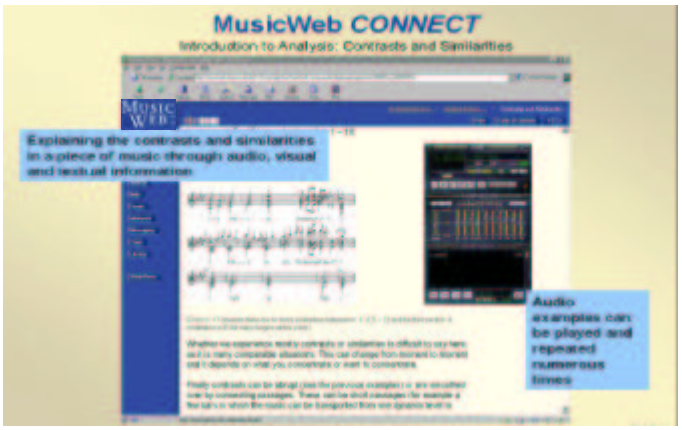
The project provides the means whereby new modes of learning and the delivery of learning are developed for the study of music. The emergence of universal networking and easy access to information via the internet enables self-paced, open learning, which can provide higher standards of learning-outcome than traditional methods by providing a high quality, highly flexible computer-based complement to classroom learning which encourages and sustains student confidence and independent learning skills.

The physical outcome of this project is a pool of music-education related modules (weblications) that are available to be used in a variety of ways by a variety of people. When creating and using MusicWeb materials, flexibility and re-usability of resources is encouraged. As such, each of these modules can be used:

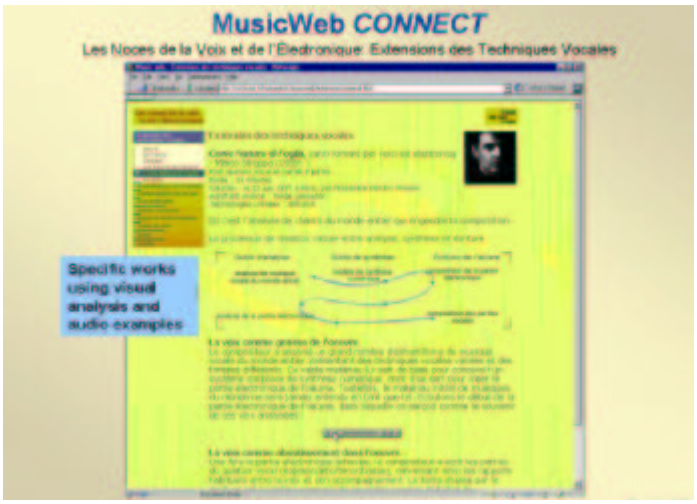
- in whole or in part,
- individually or in conjunction with one another,
- in a classroom or distance-learning situation,
- in a group, or as an individual
- or in any other possible combination of music learning-scenarios

This flexibility of use is designed to enable each user to adapt the modules and how they are used to suit their own individual needs as student (primary, secondary, higher, further and continuing education), teacher or professional, and as such, MusicWeb can be used both to complement, and as an alternative to, conventional classroom methods. Weblications can also be used for core study, preparatory material, supplementary material and as a further research resource. In addition, the modular design of the weblications enables the user to select sections and individual parts from each module (quotes, visuals and audio examples) to enhance and complement their teaching or learning styles.

This initial resource collection already comprises several hundred notated and performed examples of classical and contemporary music which have been embedded into the existing weblications, and the additional music tools and weblication-creation tools that are provided by the MusicWeb group are specifically designed to ease the process of creating new weblications. The topics for weblications and courses can be as diverse as the types of people creating and using them, and they can concentrate on core musical skills and on more specialist areas.



The aim of MusicWeb is not simply to encourage members to re-use all or parts of these resources for learning and teaching, but also to encourage the creation of additional weblications to enhance current materials with new own tools and specialist skills and knowledge. An editorial and management structure has been put in place to ensure that these new weblications meet the highest educational standards, and this creation of new weblications will continuously enlarge the resources and teaching and learning facilities available, and ensure that weblications stay up to date with ongoing pedagogical paradigms.



The MusicWeb group has created the tools to enable anyone and everyone access to these weblications, and to facilitate the creation of new modules with maximum ease. There are no specialist skills or knowledge required to use or author weblications, although knowledge of the internet is needed, and some knowledge of HTML is helpful. For more advanced users, additional training can be provided where necessary. As such MusicWeb encourages access for all, and facilitates pan-European communication between music education institutions, teachers, professionals and students wherever they are based in the world to help promote and create a positive relationship within the European music community.

All interest in joining, funding or supporting this project in any way is welcomed. For more information about MusicWeb, please contact: C.Boehm@music.gla.ac.uk or visit our website: http://musicweb.koncon.nl/connect

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Theory and Practice in the *City* Project

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Abstract

The *City* project focuses on a treatment of the city that deliberately blurs the boundaries between physical and digital media. We are combining mobile computers, hypermedia and virtual environments in one system, and allowing each person to interact with others even if they are using quite different media or combinations of media. We have found it useful to consider the many media, technologies and spaces as one design medium, because each person's experience depends on them all. People's activity continually combines and cuts across different media, interweaving those media and building up the patterns of association and use that make meaning. How people act and work is determined by the full combination of media that they can use and have used, and hence a narrow focus on technological media as the paramount determinant of activity underrates the influence of other media. Recent technological developments, including the ones we ourselves are engaged in, heighten or highlight a phenomenon already familiar through analysis of the effect of older media such as written text, maps and cinema. Our system is both driven by our theoretical approach and driving the development of theory. This paper describes some of the theoretical issues and directions we are exploring, and our ongoing system development. One of our long–term aims is consistency between theory and design practice as we work in multiple media, support synchronous and asynchronous communication, and balance subjective and objective interpretations.

1. Introduction

A city's meaning is not just in its bricks and mortar, but also in our understanding and use of it. Physical space is just one of the media that affords activity and interpretation, and at any time one is likely to have symbols in a number of media available for interpretation and use. As I step out of a train station into a city square, the printed map in my hand, the voice of a colleague on my phone, and the signs informing me of exit routes and exciting shopping opportunities are all open for my interpretation and action. Temporally, symbols in an even broader range of media may influence me, as my interpretation and activity at any point in time is influenced by my past experience and my expectations of the future. Past experience may include my previous visits to that city, seeing television footage of the city, experience of magazines, books and films about urban life, and so forth. Our understanding and expectations of life in the city influence our activity as much as immediately perceptible physical phenomena such as texture, sound and light. For almost a century, a fundamental tenet of linguistics and semiology has been that such low-level physical phenomena are interpreted by a person via language, by the patterns of activity that the person has experienced in any and all media.

The *City* project aims to weave digital information into the physical streets, buildings and artefacts that people use, and to do this in meaningful ways i.e. ways that fit, show and support their activity. We wish to work with something richer and more complex than a collection of isolated pieces of information and media. We also wish to move beyond the traditional systems of classification and categorisation that too often over-objectify information and activity. Computer scientists tend to focus on the obvious differences between physical and digital media, and treat each one independently. Here, a broader viewpoint takes account of their similarities and interdependencies.

We are creating a growing and evolving body of individuals' paths or narratives through the people, places and artefacts associated with the city of Glasgow. An initially static collection includes images, textual descriptions, and references to locations in the city, to artefacts in museums and exhibitions, and to electronic resources such as web pages and virtual 3D environments. Later, we will allow this body of information to grow as people use it, making new associations between symbols and adding in new ones. These evolving inter-subjective patterns of association and use will thus complement the static or *a priori* categories, type systems and indices that partition artefacts, spaces and people. We are building systems that afford information access based on both objective and subjective bases.

While the project will gradually extend the range of places and topics it handles, the initial focal point is Charles Rennie Mackintosh, the architect, designer and artist. A rich body of 'people, places and things' related to Mackintosh exists here in Glasgow. Examples include his reconstructed house within the Hunterian Gallery and Museum, the exhibition room devoted to his life and work within the Lighthouse Centre, and of course the buildings he designed such as the Art School and the Lighthouse itself. The Hunterian and the Lighthouse have agreed to be partners and test sites in this project, and in other related projects within the six year, eight site and £11,000,000 consortium called 'Equator'. Equator (www.equator.ac.uk) is an 'interdisciplinary research collaboration' funded by the UK's Engineering & Physical Sciences Research Council and involving computer scientists, sociologists, psychologists, artists and designers. University College London, the Royal College of Art and the universities of Bristol, Glasgow, Nottingham and Southampton are taking part in the City project, with Glasgow as lead.

A phrase or motto often appears when Equator is first mentioned in papers and PowerPoint slides: 'to bridge the physical and digital.' As with other Equator projects, City addresses this issue both at a theoretical

level and at the level of technological systems and devices. In the next section, we will discuss the theoretical side of our work. The following section then focuses on ongoing system development and demonstration.

2. Spaces, Media and Technologies

We often focus on the obvious differences between physical and digital media, and treat each one independently. This is the case in contemporary HCI and computer supported co–operative work (CSCW), and the distinction between space and place is a recurring topic in HCI theory and design discourse, in part because of new digital and informational 'spaces' (Harrison and Dourish, 1996, Chalmers 2001). Here, we emphasise the similarity and interdependence of media, and explore notions of information and language based in (Wittgenstein 1958) and the philosophical hermeneutics of (Gadamer 1989) and (Ricoeur 1981). Our information, understanding and expectations of life in the city influence our activity, and are resources for activity, as much as physical structure. As with the word or the text, and to paraphrase Wittgenstein, a city's meaning is its use in the language.

Space is interwoven in our activity and language. Shaping and motion are interpretive acts i.e. we consider spatial activity as part of language. This is not to imply that every action is consciously constructed and explicitly performed. Such activity can be explicitly planned and crafted, as in the design of a building, a choreographed step, or a sprint to catch a bus. It can also be mundane to the point of being implicitly or unconsciously done, e.g. in how one puts a book on a table, faces someone while chatting, or strolls a supermarket aisle. We consider a 'place' to be a space interpreted as a symbol in language, given meaning by its patterns of recurrence in human use. This interpretive act happens in the same way that a pattern of sound waves can be a word, a curve of ink can form a letter, a move of the hand a subtle gesture. In each case, the former is a perceivable pattern in one or more physical phenomena, which has the potential to be used symbolically, while the latter is the symbol in language. We continually mix phenomena in our everyday communication, and spatial media are an essential part of that mix. While space has its unique characteristics that differentiate it from other media, it has no privileged position above or apart from them. The meaning of a space is its use in the language, as understood in and through the activity of those who use it.

Media spaces, virtual worlds and all technological forms of representation would be useless if they did not overlap with and share references to the patterns of symbolic activity of verbal, written and gestural language, and hence with the activity in everyday physical space. As Harrison and Dourish put it, "after all, a virtual world filled with virtual offices and virtual desks isn't populated by virtual people, but by real ones."

Although we continually explore new combinations of media, many combinations that include technological media are now insignificant, mundane, and everyday. For example, if I read an email and then speak to a colleague across the room about the message, neither of us would comment on the bridge between electronic and face to face communication. If I look at a sculpture then glance at its caption, all the while listening to an audioguide, the correspondence between the three media is unlikely to strike me as remarkable in itself. It is not that there is no difference between communication via email and talking to someone in the same room, or between sculpture, text and speech, but we are familiar enough with the constituent objects, tools and media to act through them i.e. to act in normal, everyday manner. They are so interwoven with everyday life that they are no longer worth noticing as special, novel, or even distinct.

We can not claim that the distinguishing feature of technological media is their difficulty of use, in that they limit or transform our perception or communication. This is a feature shared by all media. The limited field of view of the eye and the compression of perspective, a city street's constraints on view and motion, and one's finite experience and current context—these also limit and transform what one perceives and hence influence how one interprets the 'natural' world. What makes a medium distinct or differentiable from others *is* its characteristic limitations and transformations. One can understand a new medium, technology or design in terms of what it physically affords, but also by understanding it in terms of issues such as individual and social, focal and contextual, local and remote, and past, present and future.

Many electronic and digital media are familiar and assimilated into everyday life, so that activity is no longer exotic, foreign or 'virtual'. Do we imagine that when the telephone was invented, its use was not just as difficult and disjointed as that of 'virtual worlds' today? And why, for example, don't people say that they are 'entering cyberspace' when they talk on a digital phone, play a CD, or watch a digitally–recorded film? Only a few years ago, wide–eyed Wired readers often used 'cyberspace' when referring to email, newsgroups and the Internet. Nowadays this term seems slightly embarrassing and gauche, and 'virtual worlds' and 'virtual reality' are heading the same way. Why don't we use these terms to describe computer

games, for example? The technology and the media involved are either the same or similar to VR, but the familiarity and design quality are not. Virtual worlds may, for the moment, strike us as strange and separate but they are part of the same reality and the same world—of work, leisure and society—as other media. Their novelty will pass if we use them, as happened a long time ago for the book, cinema, television and radio, and is now happening for email, computer games and the Web.

Difficulty in using such a combination of media stems not so much from the fact that a combination is involved, but that the particular representations and interactions in that instance of a combination, i.e. the overall design, is a poor fit with the people and their activity. Willem Velthoven suggests that multimedia is just a combination of sound and image that is too badly designed to be called 'film'. He exhorts us to get over the novelty of 'new' media, and to use and combine them with all our other media. Focus on good design and communication—on *monomedia* (www.monomedia.org).

As we use novel media and combinations of media, we weave them together, appropriate them for our own ends, and make them part of our everyday lives. When we recognise that many digital and electronic media are already part of our everyday lives, Equator's aim to 'bridge the physical and digital' might seem rather antiquated or odd. Since we can now see that these two are already aspects of the same world, the boundary line of Equator is not between physical and digital media as such, but in that area where appropriation of mixed media is happening and where we make appropriation happen. Equator should be seen not as a static line between physical and digital, but as a shifting and shadowy grey area between familiar and unfamiliar combinations of these media, between everyday and novel, between appropriated and experimental.

The combinations of technologies and media that Equator explores will initially be novel or unfamiliar enough that the combination is itself the focus of attention. Our work will then be directed towards making the media workable as much as towards working with it. At first this will mean workable by us, the technologists, but we must aim to widen our view and loosen our control so that others can experience, explore and express themselves through these media. New mechanisms, devices and systems afford new forms of design, work, leisure and society. Our work should be based on an understanding of how they might be appropriated into everyday life as well as some idea as to what aspects of life they may create or destroy.

Therefore, we should show a balance between being technologically driven and critically aware. We should be selfish and creative while also being socially responsible and responsive. This may at first seem contradictory, but it is a necessary reaction to the fact that, as with anything we create, we cannot fully predict how new technology will be used and appropriated. Making something new demands difference, creativity and individuality. It is technologists' awareness of the use and effects of their work that are often criticised, rather than their creativity. Artists' and designers' work is very similar, as they express new possibilities for use and interpretation in their work too. Both groups simultaneously create individually and intervene in others' lives. The 'users' of one group are the audience of the other, and the community, market or habitat of both. Our work with people such as the RCA Computer Related Design group requires our understanding and integration of contrasting and (happily) contradictory uses and interpretations. Opening up our work to public view lets more of the people whose lives will be affected by technology and design influence their development. If we claim that our work will ultimately help, enrich or inform them, they can help, enrich and inform us by offering interpretations and uses that change and intervene in our activity.

3. System Design and Implementation

We are beginning with a relatively small, controlled environment, the Mackintosh exhibition room in the Lighthouse, where visitors can use a mixture of technologies to get information tailored to ongoing activity. This tailoring is based on their ongoing motion through the room with the artefacts and information they have recently shown an interest in, and how these relate to they ways that other people have interpreted them. We then aim to extend the work to the Hunterian's Mackintosh House, and then to streets between the two, to more people, to a wider range of information, to a larger city area, to different cities… and so on, as far as our interest takes us.

Our work involves combinations of static and mobile devices: small portable devices communicating via wireless networks with each other, with large, static display devices, and with server machines across the network. Later GPS and other larger–scale communications media will be added. Servers store historical and cultural information as well as people's paths, tours and explorations. Large static displays can offer the resolution and space to show information too detailed and large for small mobiles to handle. Mobiles can be 'ready to hand' tools that afford not just portability but also individual control of shared technology. For example, a mobile can be used as an input device to control a large display, and of course as a personal source of audio and graphics. It does not

just allow a person to carry with them his or her own ongoing information. It can serve that person as a key that represents a role or capability that he or she has, as an identifier to say who he or she is, or as a locator to say where he or she is.

We do not consider the images and fragments of text as our fundamental or central data. We wish to avoid making yet another database full of sterile bits and pieces about dry exhibits, dead people and empty buildings. We represent the paths or narratives through such symbols, i.e. points of view and interpretation of how people have used them, possibly implicitly expressed, that in turn afford reinterpretation. Also, we are not focusing on more tightly structured or scripted activity characteristic of traditional work. To use Schmidt's metaphor, we are focusing on maps not scripts (Schmidt 1997) i.e. on resources for activity and interpretation. We mix the work of the author, curator or guide with the leisure of the tourist or visitor in the cultural city setting. We do not intend to make these paths just by ourselves, but to have a number of parties contribute their own interpretations of the 'raw' data and of existing paths. In the course of this creative process, they might wish to bring in additional images, references and so forth, and we will support this. We will begin with the official or 'high culture' views of Mackintosh and the city, with our editors or authors including Mackintosh curators as well as other workers within cultural information and institutions in Glasgow. Then we will open their paths or narratives to visitors and residents of the city from a number of communities and backgrounds, and activity will be recorded and added to the set of paths.

We are now building a central information resource, accessible via a variety of media and devices, that stores the paths/narratives in our system as well as the elements or fragments combined within them. While we have started with a static collection in our first prototype, this resource will later support additions, deletions, annotations and associations that are, ultimately, necessary to make the collection reflect ongoing use by a widening set of users. Here we draw on Southampton's experience in hypermedia systems, and work at Bristol and Glasgow with dynamic information services tailored to small handheld computers. Nottingham has developed a new and highly flexible middleware system, Equip, that offers a shared and distributed data modelling. This serves us well in integration work within the City project, and we expect that it will ease later collaboration and co-development with other Equator projects such as CityWide, a project centred in performance and involving Nottingham, Southampton and the theatre group Blast Theory.

Another piece of infrastructure that is used by one or more devices is a set of systems for location tracking. In the case of location in a virtual environment, each person's location is easily obtained from the VR system. In the case of someone using a hypermedia document system, 'informational location' in terms of the recently used documents and links can also be obtained relatively easily. More difficult is physical location in the city or in a room. We can use GPS tracking and RF tags (often used and to more roughly and intermittently track location in the city. We are initially working inside exhibition rooms, where we use more fine-grained and continuous ultrasound tracking from U. Bristol. We can track a handheld computer to within 20cm at an update rate of roughly once per second. Note that a person can have a location or context that involves all three media. For example, he or she may be standing in a particular square in the city, reading a document describing its history, and using a virtual model of the city to fly around it and get a feel for the neighbouring streets and skyline. More generally, and reiterating a point from the earlier section, the project wishes to explore the interwoven and interdependent nature of such media, treating them as one holistic design medium, i.e. human activity, rather than as isolated parts. We do not treat any one aspect of location or context as ultimately dominant, but instead try to support one's shifting focus, use and combination of them.

We intend to afford access to paths via audio, wearable computers, tablets and VRs. In the first case, we would generate a stream of verbal and non–verbal audio, supplied to a phone or a computer that a person would carry. The audio would describe the artefacts close to the person, adjusting the information given based on his or her location and motion, and the choice of paths and expressions of interest in artefacts and information along the way. Steve Brewster at Glasgow has experience in using positional audio, that makes sound appear to emanate from a particular direction around the person's head. This can be used to guide the user and to aid discrimination amongst multiple sources of sound. In the second case, we refer to a wearable computer with relatively small graphical displays, audio interfaces and a variety of context sensors integrated into a 'CyberJacket'' as developed by U. Bristol. These wearables are of particular applicability to places such as the Mackintosh Room, where we use available fine–grained tracking of location and direction. A tablet refers to a laptop-like computer with wireless network communications, and it may have greater computation and display facilities than a wearable. Again we can do some fine-grained tracking here, but we can show textual documents, 2D

Figure 1. The view of a VR visitor in our first partial prototype, with Mackintosh information and representations of a physical visitor. The physical and digital rooms are the same size, and have similar posters and furniture in matching locations. Video from the physical room was streamed into the digital room, showing the physical visitor (Cliff Randell). Cliff's handheld computer is tracked via ultrasound detectors, and this position is represented by the blond pigtailed 'avatar' in the centre of the image. The VR visitor is also tracked, and shown as a labelled dot moving on a room map on the handheld. Audio streams support direct communication between the two people. The text to the left is reversed as it is on the wall nearest to us—made transparent to let us gain this image.

and 3D graphics and animation, and so forth. In VRs, we refer to more high–end graphics systems that convey sophisticated 3D graphical and audio display of virtual environments, including immersive displays such as that of UCL and another Equator partner, the Glasgow Science Centre. Using such a system, a person would see a graphical model of the city with the paths overlaid, linking and interweaving the artefacts and spaces that make up the exhibition. VR and handheld/wearable systems are now inter-operating so that a person using a PDA can see another person using the 'same' room, and vice versa, as in Figure 1.

An important aspect of this variety of media and devices is that we expect people's activities in each medium to be perceptible in all media. This will mean that synchronous users, possibly using different media, are made aware of each other and can directly communicate with each other. An example would be that of a person walking along the physical Buchanan Street, with a wearable that is tracked. That person's activity would be represented inside a virtual model of the city. Someone in London, exploring that virtual city, would have his or her activity tracked too, as would someone in Iceland browsing the hypermedia documents about that street. The first person's wearable could show if the Londoner and Icelander were available for a chat, the Icelander's documents could have temporary annotations with similar information, and the Londoner would see graphical representations of the Glaswegian's and the Icelander's activity and approachability. Again, we see human activities that span and connect media as being at least as important as the characteristic design affordances that differentiate and distinguish particular media.

Our design approach also means that use of each medium would be recorded in the central information resource, and made available for interpretation by people using the system later. This asynchronous communication will be in the form of explicit annotations and additions, in graphically presented paths/narratives of earlier authors and visitors, and in contextually specific recommendations of people, places and things. In the latter case we would use Glasgow's *Recer* system (Chalmers et al. 1998) that makes recommendations by comparing each person's ongoing context with his or her past activity and/or the past activities of others. Past activity here is represented by a time-stamped log of locations, documents, artefacts and people that each person has interacted with in all of the media we can: that person's *path*. As discussed in (Chalmers 1999), this approach to representation is based on a combination of aspects of the urban design theory of (Hillier 1996), structuralist (and post-structuralist) linguistics

(Saussure 1906/1983), and the trails of *As We May Think* (Bush 1945).

Irrespective of the media involved in logging and display, our algorithms for searching, matching and recommending do not rely on distinctions between these original media. They rely on their patterns of co–occurrence in human activity and hence in common semiological use. It is this change in emphasis that lets recommendations bridge across media usually held as separate in information systems, and lets us work with this everyday mix of types rather than against it. For example, a person who has been looking at the original chairs and tables made by Mackintosh may get recommendations of other physical artefacts to look at, but also of digital documents and virtual locations that might be of interest. These recommendations may come from people who have never seen the physical furniture, but have explored related digital information. One is offered information based on one's current location and the route one has recently taken, the information read and written, the artefacts one has shown an interest in—and how this activity relates to the activity of earlier readers, authors and visitors. The past routes and paths of curators, designers, authors and visitors are combined with current context to suggest recommendations for the immediate future.

At the time of writing, we have not integrated a hypermedia interface to the same room yet, but will do within the next month. We will also integrate the recommender system within two months. We are currently collecting our first authored paths, and installing equipment in the Lighthouse's Mackintosh room. Apart such technology development tasks, we have recently begun a study of the combination of traditional and new media, through a series of semi-structured interviews with curators and exhibition designers in a number of UK museums. We are also just about to start a sociological study of the activity and interaction of city visitors and residents. We continue to explore the philosophy of language, phenomenology, neuroscience, evolutionary linguistics, and urban design theory. These studies and readings will feed into later system design work and in reflection on our first full prototype. We plan to be able to demonstrate this prototype by October 2001, with synchronous and asynchronous awareness across all three media supported, paths interweaving symbols from all media and used as a resource for recommendations, and first experiences of non-Equator people to report and discuss. More up to date information can be found via the author's web pages.

4. Conclusion

Activity stems from previous understanding, but also feeds back into understanding by creating or reinforcing associations between individual objects, individual spaces and individual people. Individual action in its social context binds technological systems and artefacts into our everyday work, leisure, language and culture. A person's movement through data, through the city and through society adds to his or her understanding of information, places and people. The City project aims to support and explore this interpretive process. It also aims to explore technologies that blur the boundary or distinction between physical and digital media, to improve information systems by representing and adapting with activity in multiple media, and to make manifest more of the design, communication and understanding that changes the city from space into place.

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Modeling synergy within research groups through metadata analysis of content objects

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Abstract

This paper proposes a model for the mining of content networks for the purpose of uncovering areas of potential synergy within research groups. This model is based on the assumption that there are a number of implicit factors shared among content objects that, though real, cannot be measured directly (latent variables). These latent variables reveal themselves in the various aspects of content objects that can be observed and documented (manifest variables). The application of this paradigm is an objective and democratic process rather than a hierarchical classification system. To illustrate the data analysis feature of the model's implementation, Principal Component Analysis was applied to the metadata associated with CIRCUS research papers. The proposed model is a potential answer to the challenge of applying architectures of information to the description of culture. It may lead to the development of a virtually self-sustaining system that will foster synergistic collaboration among research groups, allowing ongoing interpretation of the hidden inter-relationships between content objects.

1. Introduction

The work of research groups entails the production of ideas and, effectively, the production of content. Information networks and new media pose a challenge to research groups in the area of data capture, management and delivery. Long-term research programmes also generate large content databases, which present particular opportunities. However, beyond mere linear, hierarchical archives, a real engagement and integration between content and information systems is possible. These networks make for very efficient communication, and thus collaboration. This gives rise to distributed cognition, collaborative education and collaborative creative work under an emerging network aesthetic. These approaches are spearheading networked research tools and environments.

Interdisciplinary research groups exist as networks of diverse research cultures. Among the advantages of these groups are the pooling of resources to look at many sides of a problem. One disadvantage may be that harbouring many different viewpoints can present difficulties in terms of active collaboration. Synergy is very desirable in the context of interdisciplinary and otherwise heterogeneous research groups. The emergence of exceptionally fruitful collaborations combining expertise from vastly different disciplines can be seen as the result of synergy in action. These collaborations can be said to be synergetic when they yield results beyond what would have been possible were the partners working separately. Thus, synergies indicate combinations that are somehow "greater than the sum of their parts." Overlaps in theory and practice may exist between disciplines that have previously been considered distinct. The flashpoints of synergy are at these intersections. The challenge is to find these commonalities, in order to promote the synthesis and convergence of ideas.

This paper proposes a model for the mining of content networks for the purpose of uncovering areas of potential synergy within research groups. This model was developed during the conceptual and planning phase of a European Media Master of Arts student team project commissioned by the CIRCUS research group (Content Integrated Research into Creative User Systems, http://www.circusweb.org/).

2. Conceptual model

Our aim was to devise a data-driven model that would add a dimension of objectivity to the development of synergies. We wanted metadata (i.e. the characteristics of the content) to speak for itself as much as possible. The model we propose is based on the assumption that there are a number of implicit factors shared among content objects that, though real, cannot be measured directly (latent variables). These latent variables reveal themselves in the various aspects of content objects that can be observed and documented (manifest variables). However, it is first necessary to have a collection or clustering of manifest variables before it is possible to "zero in" on and define any underlying patterns. Correlations within these collections of manifest variables occur by virtue of their relationship to latent variables. By encoding the set of manifest variables numerically, the problem of identifying and characterising synergies reduces to a well-known and widely understood statistical problem of multivariate data analysis. A large family of statistical tools exists for discovering underlying structures within data sets through analysis of manifest variables. While the

identification of latent patterns using these statistical tools is a matter of relatively straightforward algebra, the understanding and naming of any synergies that are uncovered is a creative process, which lies at the heart of the art of empirical modelling.

Among the users contributing to a given content network, there are two roles critical to the above model. Authors are responsible for the tagging of their content with metadata (manifest variables). Editors are responsible for interpreting the underlying synergies revealed by the model (latent variables).

3. Implementation of the model

3.1. Metadata matrix

A meeting of CIRCUS in February 2001 (entitled "What is knowledge in an creative context?") raised the following challenge: that of codifying the cultural so it can be understood by the information system. In the spirit of this, within our model we propose a metadata matrix intended to quantify the characteristics of latent synergies. The metadata matrix is an array of characteristics which apply to every content object in the content network. Analysis of these characteristics is at the heart of our model. The validity and usefulness of inferences made on the basis of the model depend heavily on the quality of the metadata matrix.

Variables within the metadata matrix should point toward topics, themes, theories and practices, etc. related to the work of the client research group. These should, in turn, be applicable to the content so that authors have various angles from which to reflect on their content. Authors must be able to describe their content fully using the variables within the metadata matrix. Most of the set of metadata variables should be applicable to the majority of the content, and metadata should provide good coverage of the content with few gaps. It is important to exercise great thoroughness, and to carefully consider the author's point of view so as to avoid "surplus" non-applicable variables. Every Author should be able to answer all of the questions. "Not applicable" or "don't know" answers are not optimal for automated data analysis. In this way, topic relevance (from zero through low, middle and high relevance) is suggested as a serviceable, continuous variable type. The main question for content providers will be, "Which are the appropriate topics?"

Metadata matrix design should ideally be aimed at data analysis outcomes that indicate any latent variables as possible synergies. Interesting potential synergies should be allowed to emerge, and thus the data itself ought to be of interest in terms of workable synergy. Conversely, for example, if a connection is found between two variables, such as "markets" and "marketing", it may be more likely to point toward an artefact or bias in the data matrix than a meaningful synergy. It would help to reduce the number of variables if there are few inherent overlaps between variables. It is also important to "give the synergies room to move" with a sufficient range of variables so that interesting new combinations are allowed to occur.

A balance must be struck between a short and painless questionnaire to ease metadata capture for authors, and a high enough number of metadata variables to give meaningful results. There is a minimum number of content objects to be balanced with a sufficient number of metadata variables. Reliable results for principal component analysis, "a large-sample procedure," require a pool of content consisting of 100 objects, or five times the number of metadata variables being analysed, whichever is greater [1]. The final number of variables may range, for example, from 20 to 40 variables, and thus from 100(=20*5) to 200(=40*5) content objects or more will be needed for the first analysis. Developers may wish to begin by asking research groups to contribute as many ideas as possible, so that these can then be short-listed and refined.

3.2. Data analysis

The simplest of multivariate statistical methods aimed at characterising latent variables is Principal Component Analysis (PCA) [1-3]. It belongs to a larger family of techniques known as Factor Analysis [1-3]. For complex patterns of latent variables, Structural Equation Modelling may be appropriate. We focused on the simplest of these techniques, PCA, which is sufficient to illustrate our approach and generally yields the same results as more sophisticated techniques. Statistical issues with regard to these analyses (model assumptions) are covered extensively in the literature [1-3] and will not be addressed here.

PCA identifies independent latent variables in the metadata. Each latent variable is characterised by its correlation to certain manifest variables. The more important the latent variable, the greater the number and strength of such correlations. This feature is expressed as the *eigenvalue* and/or the proportion of common variance explained. The strength of the relationship of each manifest variable to each latent variable is expressed numerically as the *eigenvector*. The degree to which a particular object contributes to a given latent variable is numerically expressed as the *principal component score*, which is the sum of the manifest variable values, weighted by each eigenvector.

Editors can track the evolution of synergies, and may choose to repeat data analysis when a substantial number of new content objects are added to the metadata matrix, or when previously identified synergies seem to be waning.

3.2.1. Example

For purposes of illustration, the results of principal component analysis of the data set underlying a visualisation tool developed for CIRCUS by Audiorom are given here. The Audiorom visualisation tool or thematic filter (http://www.circusweb.org/audiorom_index.html) used a very simple metadata matrix. Eight topic themes were rated on a four-point scale from low to high relevance. The researchers performed a statistical analysis using PROC PRINCOMP of SAS 6.12 software (SAS Institute, Cary, NC, USA).

Principal components are the latent connections that may underlie manifest characteristics. In the case of the Audiorom data set, the manifest variables were the eight topics, each of which were rated by relevance to the research documented in CIRCUS papers. Strong principal components (i.e. potential synergies) can be identified by looking at the proportion of correlation within the data which they explain. Eigenvalues greater than one indicate principal components which explain multiple correlations, i.e. those involving more than two variables. Analysis of the data set uncovered two relatively strong principal components and one weak one (Table 1).

Table 1 Principal components within the Audiorom data set

	Eigenvalue	**Proportion of correlation explained**
PC1	2.5	31%
PC2	1.8	23%
PC3	1.2	15%
PC4	0.9	11%
PC5	0.6	7%
PC6	0.5	6%
PC7	0.3	4%
PC8	0.2	2%

The second principal component (PC2) revealed that certain topics (i.e. "Arts and technology", and "Creative and performing arts") were both rated highly relevant to many documents within the collection of content (Table 2). From this we may assume that there is a connection or synergy involving these two topics. However, within this principal component, the topic "From experiments to markets" is negatively associated with the others. This means that the topic is not a part of this underlying connection. Both positive and negative connections are helpful in interpreting and evaluating potential synergies.

Table 2 Eigenvectors for principal components within the Audiorom data set, selected for strength

	Topic variables							
	AT	PR	CD	CP	CC	EI	PM	EM
PC1		-0.4	0.5			-0.4	0.4	0.4
PC2	0.6			0.5				-0.5
PC3					0.7	-0.5	0.4	

Legend**:**

Code	**Topic**
AT	Arts and technology
PR	Pedagogic research
CD	Cinema and digital media
CP	Creative and performing arts
CC	Creative and cultural metadata
EI	Extensions of the interface
PM	Production methodologies
EM	From experiments to markets

3.3. Editorial tools

A set of editorial tools would streamline the data management involved in the implementation of our model. These tools would support editors as they perform data management tasks at the synergy level. Editors should be able to accept or reject potential synergies that arise through data analysis. The clustering of content within certain synergies could also be mapped. The editor would also be able to save previous synergy configurations for the purpose of historical tracking of synergies, which would show content convergence and divergence. These editorial tools would also aid in interpretation of synergies, helping editors to make sense of patterns emerging within the content. graphical visualisation tool would make these underlying connections visible. Graphical visualisations to support these editorial tools could take a variety of aesthetic and visual forms.

For instance, the Audiorom thematic filtering tool provides an interactive way to explore combinations of topics. This is a step in the right direction, as there are marked differences between the clustering of content shown in the views where selected topics ("Arts and technology" and "Creative and performing arts") are involved in the second synergy (Figure 1) and where an additional selected topic ("From experiments to markets") is negatively associated with the synergy (Figure 2). Clustering of content due to high topic relevance reflects a connection between the synergetic topics. This type of visualisation could be extended through the application of data analysis, so that the important manifest variables would stand out. This more targeted and clearer visualisation would help to characterise the pattern of potential synergy for editorial interpretation.

Figure 1 Audiorom tool snapshot showing clustering of content objects, with selected topics relevant to the second principal component

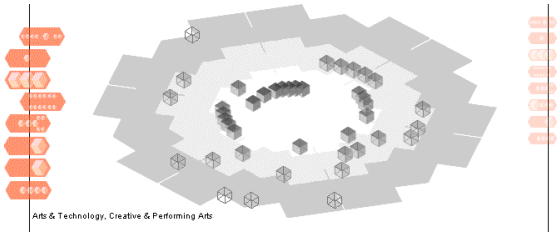
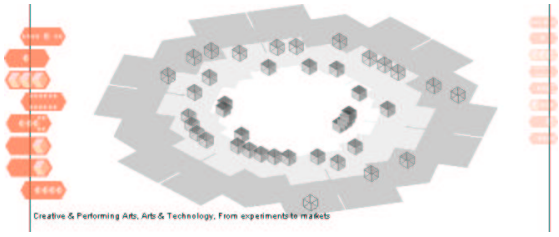


Figure 2 Audiorom tool snapshot showing distribution of content objects, with selected topics relevant to and negatively associated with the second principal component



A set of visualisation tools which literally visualise the underlying connections would go one step further. A variation on a scree plot would show the relative strengths of potential synergies, and would act as a guide for editors in selecting relevant synergies. Another graphical tool would plot the principal component scores for content objects which formed a part of the previous analysis alongside scores for objects which were added to the content network after analysis. Synergies that score low, and thus appear not to hold for the new content could be seen to be weakening. This reveals the cyclic nature of editorial data management tasks.

Carefully designed interactive visualisation tools would be an essential component of the implementation of our model. These would be among the partnered tools drawn in to form an integrated networked research environment. The research group's metadata would be coded into the metadata matrix. Content authors would fill this matrix with data using a front-end based on a customisable data capture tool. Scalable, automated statistical analysis would form the basis of the set of editorial data management tools. Wiki (http://c2.com/cgi/wiki), a collaborative hypertext authoring tool, would be an appropriate gathering place for a distributed editorial board to discuss the definition and interpretation of potential synergies. This system also encompasses data delivery: visitors would also be able to access visualisations of the data in terms of synergies arising from the content.

4. Discussion

4.1. Limitations

Our model relies on a large content network containing sufficiently numerous content objects. A devoted author base is needed in order to build a sizeable metadata matrix. The initial design of the metadata matrix should engage the considerable efforts of many members of the research group.

Bias and error may be introduced into our model in several ways. During the development of the metadata matrix, metadata variables chosen may be weak or non-descriptive. Authors may tag their content erroneously, or inconsistencies during metadata capture may introduce too much variability between authors. Finally, in spite of all efforts to the contrary, editors by definition have extensive powers to introduce their subjective opinions during synergy interpretation.

4.2. Advantages

Our model applies the strength of rigorous statistical techniques to the analysis of content networks. It is capable of handling vast amounts of information consistently, enabling editors to make sense of this information. As a research tool, it provides reproducible and defensible results. This gives rise to a deep and harmonious meld between content and the information network. This manifests itself in two ways. Firstly, content is made understandable by the information system by way of the metadata matrix. Secondly, the information system recognises synergetic patterns within the content that emerge from the data analysis. In this way, this is a system that generates knowledge. One especial benefit of our approach is that surprising connections between apparently disparate concepts could arise from data analysis. These may be connections that would not otherwise have occurred to members of the research group.

Lastly, our model involves a democratic approach, in which the decisions of authors form the basis of the model. This is in sharp contrast with a hierarchical system in which the onus is placed on the editor, who must judge if categories need to be adjusted, and subcategories moved or created. Rather than a system that merely reflects editorial decisions, our model allows dynamic and organically evolving synergy themes to arise from the data itself.

5. Conclusion

We have placed content at the centre, so that our model for identifying synergies is essentially content-driven. This model is a potential answer to the challenge of applying architectures of information to the description of culture. It may lead to the development of a virtually self-sustaining system that will foster synergistic

collaboration among research groups, allowing ongoing interpretation of the hidden inter-relationships between content objects.

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CORPOREAL TECHNOLOGIES

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ABSTRACT:

The emphasis in computing science and engineering research is shifting to the body as the location for the pervasive, distributed, ubiquitous and mobile technologies of today and tomorrow. However, this shift doesn't tend to recognise the particularities of unique bodies, preferring to focus on social bodies, groups and communities of readers and users. This short article turns away from these patterns of connected and communicating [electronic] bodies to focus on the relationship between emerging technologies and the unique corporeality of the dancer.

Dance technique has assimilated new information from the fields of biology and physiology as well as transference of dancing knowledge across cultures. A short historical overview of theories and practices of dance technique in America and Northern Western Europe leads to the observation that the trained dancer is as culturally as they are physically constructed, each trained body a repository for a particular kind of information accumulated through time.

The article shifts to an analysis of aspects of the working process of a contemporary choreographer, William Forsythe. Forsythe takes the tradition of ballet as his starting point, but has used techniques for generating complex movement material and compositions that borrow heavily on computational processes – in particular the ways in which 'algorithms' can be used to generate emergent movement material both in rehearsal and improvisational performances. The dancers have been selected for the company on the basis of their unique physical and mental abilities that enable them to perform these complicated operations.

After looking at how inspiration for dancing and dance making may come from some of the processes of computation (as opposed to direct human computer interaction), the article considers the question: what if the unique body of the dancer were placed at the very centre of HCI research with the aim to enhance the environment for the instruction of the dancer? This proposal for a new 'smart studio' closes the article and brings it full circle by suggesting that such a project would spawn mutually beneficial collaborations between dance artists and computing science and engineering researchers.

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[1] Unique Bodies

In the last few years, the discourses and practices of new media and emerging technologies seem to be returning in orientation to the body – to *human centred* computing. The emphasis on virtual realities, cyber and machine spaces is being displaced by concepts of pervasive, embedded, ubiquitous and mobile technologies. Countering the perceptions of technology fostered by jargon coinage such as 'meatspace' or 'wetware', the body is now seen as an essential part of the coherent and expressive self. (1) *Human centred* computing is promoting a shift in research fields such as HCI (Human Computer Interaction) away from a focus on the screen towards this essential body along with its role as part of a living network; i.e. that of self and others in the ongoing formation of fully connected and active social bodies, groups and communities.

As technology research focuses increasingly on the arts as a source of inspiration and innovation in developing human centred computing, one might expect that dance which takes the body in motion to be its primary medium of expression would be well positioned to play a more robust role in today's explorations of emerging technologies. However, within this shifting conception of where the human and the technological overlap there remains a gap that appears when one tries to thrust dance practices into a close relationship with the technology. This gap occurs because dance practice cultivates unique bodies suited especially to performing on the public stage. These bodies are formed from a process of instruction that distinguishes

them from the 'average' or normative corporeal entities such as those at the focus of most HCI problem-solving research (e.g. the search for 'user friendly' interfaces to enable more efficient production). These bodies, shaped with the aims of the art of dance in mind, can also be differentiated from the athletic bodies of the sprinter or gymnast, drilled explicitly for competitive success.

French kinesiologist Hubert Godard refers to the dancer as a "geographer, accumulating maps, intra-corporeal dispositions" out of which a history may be produced. For Godard, the dancer is not simply a 'body' but an "accumulation of corporeities" which encompass centuries of evolving forms of dance and dance instruction. However, no century quite matches the last where individual artistic innovation combined with increased physiological and scientific understandings and a greater cross-cultural transfer of corporeal knowledge has produced the greatest diversity and range of dance techniques – each giving rise to its own form of virtuosity. (2)

The most recognizable form of dance instruction is ballet, which has evolved over 400 years to emerge as the traditional form of dance technique in the West. Ballet has the strictest requirements for a preset or ideal body requiring "thin, long limbs capable of displaying the formal geometric features of the tradition" upon which success in this technique can be better guaranteed. (3) Following a variety of anti-traditionalist and emancipatory cultural movements, in the first half of the 20th century several alternative dance techniques evolved out of the work of individual artists. Some of these techniques eventually achieved, despite their revolutionary beginnings, a degree of codification and institutionalisation (e.g. Doris Humphrey, Martha Graham and Merce Cunningham all developed techniques to assist in the training of bodies capable of expressing their choreographic visions). In the 1960s and 1970s, a form of dance practice emerged referred to as 'post modern' by Sally Banes in her seminal book of that period *Terpsichore in Sneakers*. (4) Here dance training and technique was eschewed for yet another alternative concept of dancing that took at its heart the 'no manifesto' of Yvonne Rainer written in 1965 that celebrated the performing of non-virtuosi movement and activity on stage. (5) This stripping of the dance to its essential elements during the experiments in the 60s and 70s proved a temporary revolution. In the 1980s, new virtuosities appeared on the stage that profited from the better understandings of the workings of the body that arose from this fierce re-evaluation of the two preceding decades, combined with (the also re-examined) traditional forms of dance training.

While Europe also had its own early 20th century innovators developing alternative concepts of dance training and technique, in particular Mary Wigman and Rudolf Laban, World War II interrupted and relocated nearly all of those involved in such research. Laban for example, left Germany for the UK where he continued to develop his influential movement theories. (6) Following the war and well into the 1970s, dance training in Europe was inspired by the new ideas and practices coming out of America. Europeans, however, never gave up their love of the virtuosities of classical ballet, and it is from within that tradition of the 'ideal' that the latest unique bodies have emerged.

[2] Algorithmic Bodies

William Forsythe has been the choreographer and director of the Ballet Frankfurt since 1984. Trained in ballet, Forsythe has embraced the concept of the 'digital' by developing new techniques for his dancers derived from an analysis of the essential forms in traditional ballet. Out of these deconstructions, he has created a series of basic and discrete operations that are learned by the dancers. Forsythe refers to this body of knowledge as 'improvisation technologies' through which he is able to apply 'computation' processes to create emergent forms of choreography in ballet. (7) The basic operations are essentially simple ideas about matching lines and forms in space, but when combined in a series of algorithmic processes the result is extremely complex and requires rigorous practice to achieve.

Forsythe uses dancers trained in ballet technique because they have "all the reflexes of the traditional ballet dancer", the ability "to picture points in space very precisely" and the "visceral thinking that is acquired over a long period of time". (8) This training conditions them to perform the complex movements of the 'improvisation technologies' instinctively or intuitively; they will not have to 'think' before moving but are able to rely on an intelligence that resides in the muscles, ligaments, nervous

and fluid systems in the body. The dancers in Ballet Frankfurt each inhabit a unique body, each a repository for a complex set of skills, knowledge and experience derived over many years of training over which the 'improvisation technologies' can be layered.

Forsythe's choreographies are thus informed by an understanding and metaphorical application of the processes and structures inherent in digital technologies. His dancers are chosen on the basis of their ability to perform the choreographies that are based on these structures. Forsythe's choreographies rely on their ability to perform a vast repertoire of movement 'operations' that can be applied in any order, any arrangement, scaling, direction backwards or forwards. Just as not everyone can perform at a high athletic standard, it is only possible for a relatively small number of individuals to essentially compute the movement algorithms and perform Forsythe's choreographies successfully. As more choreographers assimilate the influences of digital computation into the understandings and manifestations of their creative processes – what might be the implications for the future training of the dancer? (9)

[3] Embedded Bodies

With the possibility that choreographic inspiration may be derived from increased assimilation of the structures and processes of computation, we can speculate that technologies may lead to an indirect influence on the training of the dancer. What if the unique body of the dancer were placed at the very centre of HCI research with the aim to enhance the environment for the instruction of the dancer?

Whenever training in techniques of the body is undertaken, whether in dance, sports, or rehabilitatory/ therapeutic contexts, it takes place in an environment within which there is feedback. For the dancer, this may externally depend on the touch or voice of the teacher and be internally dependent on the kinaesthetic/ proprioceptic senses. Externally, the space itself, the floor, dance bar and mirrors creates a feedback environment and observation and self-analysis is possible using video recording and playback. With this in mind, why not construct a dance training environment where the feedback is enhanced through the development of specialised embedded and wearable computing technologies?

Imagine being in a dance technique class in 2020. The floor has pressure sensors that track your ability to change the orientation of your body centre (and relative weight); posture accelerometers sewn into areas of your clothing (so small you won' t feel them) utilize aural or light contact feedback to let you know that you are losing energy in the turn because there is the wrong alignment between knee and hip. Running along the centre of the mirror will be a small graphic display letting you know if your breath and heart rate are remaining in synch. A video system is analysing your shapes in an adagio and is able to inform you that these conform to your internal sense of them or not. 3-D motion capture will be running alongside 2-D video recording and playback showing your movements from every dimension. Rather than waiting to watch this material after the exercise, they may be played simultaneously or within seconds on a large LCD screens in the walls.

This precise vision of the futuristic 'smart' dance studio may not be realised, but the collaboration between the fields of technology research and dance would serve to bridge some of the gaps that currently persist and more fully realise a future that goes beyond the rhetoric of human centred computing. For dance, becoming an embedded body will entail more than simply telling someone what is required, as for example, one might do today in building the traditional dance studio. Becoming an embedded body will encourage dance to analyse its accumulated practices of instruction and creation in even greater detail and be prepared to enter into a new relationship with corporeality – one that is pending at present but for which we have no clear view yet.

END/ END/ END

(1) Meatspace and wetware are “jargon” coinage referring to a physical body and nervous system in dehumanising terms. Free On Line Dictionary of Computing http://foldoc.doc.ic.ac.uk/foldoc/index.html

(2) Hubert Godard (interviewed by Laurence Louppe). “Singular, Moving Geographies”. Writings on Dance/ French Issue No. 15, 1996. p. 15.

(3) Susan Foster. “Dancing Bodies” in *Incorporations.* Jonathan Crary and Sanford Kwinter, eds. New York: Zone, 1992. p. 486.

(4) Sally Banes. *Terpsichore in Sneakers (with new introduction)*. Middletown, CT: Wesleyan University Press, 1987.

(5) “NO to spectacle no to virtuosity no to transformations and magic and make-believe no to the glamour and transcendency of the star image no to the heroic no to the anti-heroic no to trash imagery no to involvement of performer or spectator no to style no to camp no to seduction of spectator by the wiles of the performer no to eccentricity no to moving or being moved.” (Yvonne Rainer, 1965)

(6) Rudolf Laban, whose studies of human motion provided the intellectual foundations for the development of central European modern dance, also developed Labanotation, a widely used movement-notation system.

(7) *William Forsythe: Improvisation Technologies – A Tool for the Analytical Eye*. ed. ZKM Karlsruhe and Deutsches Tanzarchiv, Cologne/ SK Stiftung Kultur CD-ROM (Mac/ PC).

(8) Paul Kaiser. “Dance Geometry: William Forsythe in dialogue with Paul Kaiser”. On Line, Performance Research. Vol 4: No. 2, Summer 1999. pp. 66-69.

(9) Barriedale Operahouse (http://www.barriedale-operahouse.com), a group of artists based in Europe/ UK comprising programmers, composer, choreographers and graphic artists, is creating a piece of software called **ChoreoGraph** that uses computation to generate instructions for dancers to receive on the stage via a cuing system. Currently, they are building this software to be used in a piece of choreography with a pair of Ballet Frankfurt dancers to be premiered in December 2001.

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Short Author’s Biography:

Scott deLahunta began in the arts as a dancer and choreographer. Since 1992, as a partner of Writing Research Associates (WRA), he has organised several international workshop/ symposia projects in the field of performance including recently the third session of Conversations on Choreography at the Institute for Choreography and Dance, Cork, Ireland. He taught theory and composition classes from 1994-1998 at the School for New Dance Development, Amsterdam and is returning there to teach in Autumn 2000. From Autumn 1998 to 2000, he was a consultant for the Laban Centre London on dance and technology applications and implementation. From February-May 1999, Mr. deLahunta was a guest professor with the Department of Dramaturgy, Aarhus University, Denmark where he was also co-organiser of the Digital Theatre Experimentarium, a project investigating the relationship between motion capture, animation and live performance. He is frequently invited to facilitate workshops, give presentations and contribute to publications on the overlap between dance and new media technologies, most recently in Autumn 2000 at DEAF (Rotterdam), ISEA (Paris) and in Spring 2001 the TRANSDANCE Research Lab (Athens). He is currently a Research Fellow and guest lecturer at Dartington College of Arts, UK where he is conducting research, with support from the Arts Council England, into the conditions for collaborations between performing arts and applied science practitioners. In Autumn 2001, the WRA initiative *Software for Dancers* will conduct the first in a series of research labs/ thinktanks looking to develop new software tools for performance artists.

Several relevant weblinks can be found here: http://huizen.dds.nl/~sdela/main.html

Designing vector-based ontologies: Can technology empower open interpretation of ancient artifacts?

L. Diaz, M. Kaipainen

Understanding ancient times through the interpretation of remains of artifacts and fragments of data is an archetypical example of the general cognitive task of making sense of multi-faceted meaningful information that allows a number of possible interpretations. Our goal is to reconsider this freedom that is conventionally only granted to experts, such as archaeologists and anthropologists, and propose an open interpretation perspective to knowledge design, empowering the layman to explore such data using their individual cognitive maps.

This view is based on the idea that individual cognitive maps can be thought of as projections of a multidimensional *space of elementary descriptions* onto a two-dimensional level of similarities. In such a view, proximity relations on the level of similarities determine classifications, i.e., significant similarity relations on which understanding relies.

We propose a vector-based ontology that allows such projection, aiming to demonstrate how it accounts for the idiosyncratic freedom of interpreting multifaceted information. We assume each artifact to be defined by a large, virtually infinite number of descriptive features. Each artifact is represented by an ordered series of values, each corresponding to the presence or relevance of a single descriptive feature with respect to that artifact. This is interpretable as a vector defining the position of the artifact in the space of elementary descriptions. An individual understanding of the material is described as a nonlinear projection of positions in that space onto the level of similarity relations. Each projection it is different from other projections, due to an interpretative lens, a, idiosyncratic weighting of each of the descriptive features.

Implications of this approach are considered in the light of applying it to an example data. Our data is derived primarily from transcriptions and images of the Relaciones Geográficas de Indias, or from sources that are contemporary to these reports. The Relaciones Geográficas is a collection of the replies by local officials, in Central and South America and the Caribbean, to a standard questionnaire sent by imperial bureaucrats in 1577. (Diaz, 1995:258) Our suggestion is that the open interpretation approach, which essentially shifts a part of the task of interpreting available data from the expert to the client, has a potential to empower and possibly generate more intellectually challenging and innovative forms of activity. However, we identify a number of problems in defining spaces of elementary description generally and specifically enough. The constraints involved in displaying and interfacing with the data, from this point of view, are also treated.

Unmasking 3 - A Framework for the Interactive African Art Museum

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Abstract

Unmasking 3 is a collaborative project that aims to put African Art on the Web. Artists and Computer Scientists are working together to put manipulable, 3D models on the Internet. The aim is not just to display the objects but also allow them to be manipulated by the viewers and allow the results of those manipulations to be shared. In this paper we describe the rationale for our work in returning collected art works to their former owners. We also describe the technical implementation of the manipulation and sharing process. Ultimately we aim to provide a framework through which museum objects can be shared with a new audience and take on a new life.

Keywords: African Art, interactive museum, virtual reality, collaborative art

1. Introduction

The display of collected artefacts in western museums is a cause of international tension. Such artefacts have been gathered from across the globe during the colonial period and are now held by their new owners. This leads to several problems, not least is the loss of significant objects from the cultural descendants of the original artists. The western viewer also looses, to an extent, as the objects cannot be seen in their original context. Thus some of the significance of the objects is lost.

This paper describes a collaborative, interdisciplinary project, involving artists and computer scientists, in an attempt to restore collected objects to the world and restore context to the objects. The focus of the project is West African Art from the 15th and 16th Centuries. More specifically we are beginning with the interactive display of a 16th Century Bronze Queen Mother's Head from Benin (figure 1).

The head is displayed at the Liverpool Museum and 3D representations of the head are viewable from the museum's web site [1]. However, our aims in this project are, firstly, to make the head interactive and malleable by the viewer and, secondly, to allow the viewers to establish their own context for the head. Viewers become users of the head and can share their work with others via the Web. The longer-term goal will be to learn the lessons from the Unmasking 3 project to provide a framework for the truly interactive display of other artefacts.

In the rest of this paper we will; look at the history of the series of Unmasking projects that led to the current work; look at the rationale for our approach and finally look at the technical realisation of the project.

Figure 1 Queen Mother's Head

(Courtesy of National Museums and Galleries on Merseyside)

2. History of Unmasking

It would be useful to give a short history, on the Unmasking series of work. A brief description is as follows: **Unmasking 1** was conceived for as part of the MA Fine Art Media degree show at the Slade College, UCL, London in 1998. The work critiqued the language that is often employed to frame extra-cultural objects and artefacts, through the construction of a minimalist installation that focussed on the ramifications of the museum object label, in the absence of the object itself and how this situation conditioned the audience reception of the work. **Unmasking 2** was conceived and produced with funding from ArtPace, A Foundation for the Arts San Antonio, during the 99.3 The International Artist-in-Residence Program along with artists Chris Sauter (Texas), Liisa Roberts (New York), selected by Okwui Enwezor, Director of Documenta XI. Unmasking 2, a development of Unmasking 1 was an interactive computer installation that invited the public to participate in the live digitising of artefacts by bringing their own 'archive' into the gallery to be digitised by the real-time 3D scanning bench. In this way, the hierarchy of the museum object of worship was compared to the personal fetish item, whilst raising questions on the notions of the real/copy, and access to memory institutional archive. The work to date has been shown at ArtPace, San Antonio Texas, Thomas Erben Gallery, New York, SESC Pompèia, São Paulo, Brazil. **Unmasking 3** is an interactive online project that will eventually take the form of an immersive, interactive digital museum that will initially focus on but will not be limited to objects from various global public collections of African Art.

The aim of the museum is many fold, but includes the following aspects that have been developed through other projects and research by the artist, namely the artworks Unmasking (1998), Unmasking, part 2 (1999), Unmasking, part 3 (current), and the theoretical book Writings on Technology and Culture [2]:

- The possibility of exploring a more democratic and meaningful interaction/access to existing objects of cultural significance within existing memory institutions through digital technology;
- To embark on the development of an interactive online African Museum of Art, which distinguishes itself through the extensive collection of African objects that exist in disparate global locations.
- To develop the final software in such a form that it can be a useful resource in the training of exhibition curators who have an interest in dealing with trans-cultural objects and artists that produce such objects, as well as the relevant institutions that host such objects.
- To expand the project, with the help of game developers into a curatorial game, in which the user assumes the role of a cultural curator, with the task of building up a collection African art that challenges the normal assumptions of what constitutes as African art. For example, the game will situate Egyptian Art, Northern African Art, West African Art, Southern African Art in the same virtual museum; a situation that is deemed inappropriate with respect to art historical terms.

3. Rationale.

In order to understand why the artist has devoted so much mental and physical effort towards the building of an online museum, it is only necessary to examine the current situation within contemporary art practice with respect to the age-old questions of visibility of other cultures, globalisation, multiculturalism and the aesthetics of other culture's cultural production.

Such a situation, in the past has led the artist to write about the passé of the 'inclusive' post-colonial exhibition; the problematic of the quasi-anthropological stance within contemporary curatorial practice; and the (mis) representation of African Iron Technology with respect to the aesthetic aspects of the production of the African metallic objects of antiquities.

Furthermore the project is a logical development of the artist's general inquiry into the prevalent issues of cultural ethics, the role of a future art practice, and finally making sense of the artist's interest in the intersection of technology, culture, art, philosophy and politics.

Last but not least is the increasing digitising of cultural artefacts by memory institutions for

the purposes of preservation and 'virtual' interactions to which the artist feels require a critical response. These issues were covered in a recent paper delivered online through a live web cast, titled Even Realer Than The Real [3].

4. Technical Realisation

Technically, it is rather straightforward, though time-consuming, to digitise any three dimensional object for display on the World Wide Web. Similarly, it is also straightforward to build some virtual rooms in which to house and display digitised artefacts. However, such an approach merely replicates the real space and real objects in a virtual space and does not exploit the potential of the virtual. Our aim is to go beyond the positional manipulation of objects and allow the viewer (user) to truly create their own version of the displayed artefact. In addition we want to allow the viewer (user) to share their work with others.

The implementation platform for our work is the interface between VRML 97, the Virtual Reality Modelling Language [4] and the Java programming language. VRML 97 is an ISO standard developed by the Web3D Consortium. It allows the description and sharing of virtual worlds on the Internet. The 3D data is displayed in a Web Browser via a VRML plug-in such as Cortona [5] or Cosmoplayer [6] By providing interfaces written in Java we can allow the end user to manipulate and save 3D objects within a web browser.

Figure 2 VRML/Java Interface

Figure 2 shows the prototype VRML/Java interface for manipulating the model of the Queen Mother's head. The model of the head itself has been converted to VRML from a 3D Studio Max model, scanned in and supplied by Liverpool Museum. The VRML model is much reduced in polygon count in order to speed the downloading of the model to the client's machine. Figure 2 highlights the lighting control of the head. The user can control the colour and direction of the ambient lighting.

Figure 3 Control of Other Features

In figure 3 we can see it is possible to control individual features of the head such as the hat, face and neck and allow the user to set different colour values.

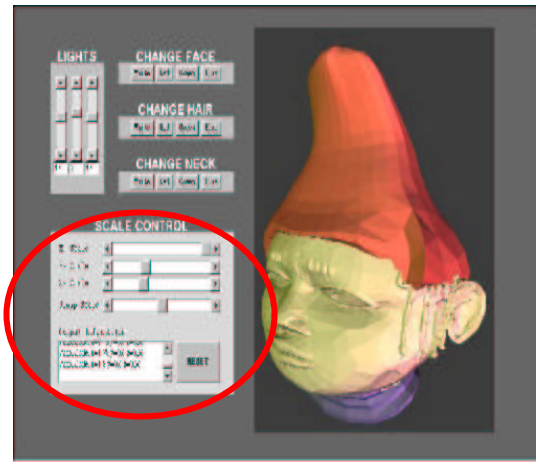

Figure 4 Control of Scaling

In figure 4 we see it is possible to control the scaling of the head in the X, Y and Z planes.

Given this initial VRML/Java framework we can now permit a number of other operations by the user on the head. For example;

- Changing the material properties such as reflectivity and transparency
- Rotation of the head in 3 Dimensions
- Setting the style of lighting

- Setting the surrounding

The deciding factor in whether such features should be added will be their acceptability to the user population. Adding more features would make the user interface more complex.

4.1 The next stages

Having provided manipulations of the head the next stage is to allow users to share versions of the head with each other. Our aim is to create a community of users who can share their experiences with working and changing the head. Again, technically, this is not a complex task, but it opens up completely new set of possibilities.

Technically, saving the users work involves saving the changes made by the user to a database. Note that only the changes are stored, not the whole model. Figure 5 shows the technical framework for saving the users work.

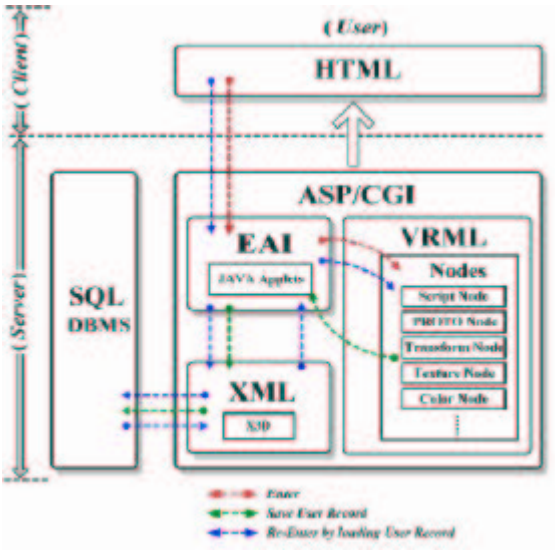

Figure 5 Complete Frame work

With the changes saved in a database we can then exploit other collaborative technologies for the users to share and discuss their work to others.

A further technical development will be the manipulation of the context of the head. Initially this will involve setting up background images surrounding the head. Users will be able to select from an, initially, small range of images.

Aside from the technical challenges we must also consider the impact of the framework on the user community. The initial prototypes will initially be assessed by workshops at public libraries in Liverpool. The Nigerian Community Centre, Liverpool will also be involved as evaluators of the prototype.

5. Conclusions

Moving objects from the display cabinet to the virtual world is not a new idea but we believe our goals, in supporting a greater range of interaction between the users and objects, and between the users themselves, offer much more potential than the conventionally conceived virtual museum. Having learnt the lessons of the Queen's Head we hope to lay the foundations for the Interactive Museum of African Art.

We hope that such a museum will be accepted by our end user communities and develop in directions that we cannot currently envisage.

Acknowledgements

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LOGICS OF VALUE FOR DIGITAL MUSIC

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Abstract

This paper will present and discuss a philosophic argument for examining the values used in the subject-object relationship of digital music exchange. Use value is what practical use the music has for the participant and is most often different for composers and audience. The symbolic value of a work involves its potential for representation of some quality beyond its structure or use-value. Sign-value (status) is what social identity audiences associate with a work, composer or genre. This is often a factor in determining who attends live performances or downloads audio files. Finally, exchange value or object as commodity is perhaps the most important for the majority of digital music consumed today. The requirement for reproduction, either through recorded hard media, in a concert setting, or over the internet poses interesting possibilities and challenges for the creator and audience of this music.

Paper

To understand music in all its current aspects, it is no longer adequate to approach analysis of the intrinsic musical values in isolation from institutional context. The current environment for music creation, production, and experience is one in which the traditional roles of composition as a private act of seeing, and listening as a public act of examination, are no longer clearly differentiated given the multiple paths currently available for exchange of digital music. The exchange possible in this music construct is a factor of the values assigned to the musical object by the creator, to the subject by the listener, and the implicit value of a method of representation that relies heavily upon simulation and in which the commodity form of value dominates social exchange.

The premise developed in this paper is an analytic and aesthetic inquiry into digitally conceived and produced music and its increasing reliance on mass reproduction and consumer driven models of valuation. Folding itself within a framework of a highly

processed world of technology and media-based communications systems, music has been shaped by the commercialization and objectification of these fields. The logics of consumption and use value have replaced the symbolic and experiential values as primary modes of evaluating musical significance. Traditional music aesthetics research has often centered on both the development of models for understanding the intrinsic value of a temporally organized work and the experience in which musical worth is ascertained. Accordingly from this perspective, the fundamental appeal of a musical work is as a construct of sounds that contains an internal logic. The value of music is derived from knowledge of the formal structure and syntax inherent in the sounds that constitute the music. The assumption was that it can only be appreciated by those with a prior understanding of the poetics and symbolic context.

In a society dominated by production, music has now adopted the functions and attributes of produced objects that one exchanges in a technologically constructed framework. Objects that previously possessed or were given a symbolic value have adopted exchange, use and sign values that are presupposed in a consumer driven society. The death of the symbol is a prerequisite for its emergence as a commodity sign. Only by dissolving itself from a symbolic exchange can the object become a true sign of commodity, available to anyone for a price, short-lived, and ultimately disposable.

As French cultural theorist Jean Baudrillard explains, "In order to become the object of consumption, the object must become a sign, that is, in some way, external to a relation which it now only signifies…."(Baudrillard 1988: 22) Thus it follows, that in consumption

> … objects are (not) mechanically substituted for an absent relation, to fill a void, no: they describe the void, in a development which is actually a way of not experiencing it, while always referring to the possibility of experience. (Baudrillard 1988: 25)

Unlike the symbolic object that possesses a unique quality and is able to endure a substantial length of time maintaining its associative meaning, the sign and exchange objects will quickly lose their meaning, becoming properly consumed, so that another can be put in its place. As a universal structure of contemporary society, this systemization of the consumption of sign objects becomes the replacement of previous symbol forms. As Baudrillard summarizes it in *Le Système des objets*, consumption becomes "a collective and active behavior. It is a complete set of values." (Baudrillard 1988: 25)

To fully realize this relationship of subject-object in digitally reproduced and consumed music, reason dictates that multiple systems of value are necessary for grasping a full meaning of music. The following four logics of value are arguably distinct in their illuminations of the nature of digitally exchanged music: 1) use value, 2) exchange value, 3) sign value, and 4) symbolic value. Within this framework, symbolic value designates traditional notions of artistic and aesthetic value and intrinsic-experiential value. It is understood that digital musical objects do not exist in isolation from these four logics. The digitally encoded language is in itself an iconic representation of the musical syntax, consequently it is related to the ties between code and reproduction.

Obviously, the use value of any music can be ascertained from the perspective of creators, performers, listeners, and scholars. The use-value of an object would be its utility related in Marx's term to the satisfaction of certain needs. For the composer, this could be a factor for career development or increasing prestige and authority. For the listener, the utility aspects are evaluated within the framework of all useful information acquired through a technological pathway, including personal, political, economic, aesthetic, psychological, moral, ethical and social forms of information. In the era of simulation, not the production, but the reproduction of objects becomes crucial. At the same time usage becomes transformed. Accessibility is the primary goal, replacing a need for live performance.

Walter Benjamin felt the original value of work of art was found in its basis in ritual. Once the criteria for “authenticity” ceases to be applicable to artistic production, the work

of art begins to be based on another practice – politics. A work becomes accessible to a multitude of people, and becomes infinitely repeatable outside the performance setting for a large number of listeners. It gains availability. It loses its symbolic volume. It becomes far more difficult to ascertain intrinsic musical values. It is divorced from any level of ambivalence and ambiguity. This is an environment in which digital produced and distributed music finds itself currently, often functioning primarily as a mass reproducible object.

Objects that are produced, encoded and exchanged by technological means are consequently subjected to and legitimated by the conditions of this methodology. Technology, crucial for understanding general knowledge in our society, follows the principle of optimal performance: maximum output for minimum input. Jean-François Lyotard called this the principle of 'performativity.' (Lyotard 1984: 37) Technology thus becomes the most efficient way of achieving the proof of an object. Given that technology costs money, an equivalency between wealth and truth or can be established. Technology tends to link whatever objects or subjects that rely upon it to the economy. Expensive technology tends to imply better achievement. This case can be demonstrated in music by the large number of electronic music studios at college and universities in the world, each attempting to demonstrate a status of possessing state-of-the-art equipment. By reinforcing technology, one reinforces one's chances of arriving at the most truth. Since wealth is necessary to fund technology-based music production, a correlate between economic control and intrinsic-musical value is thus established.

This logic of equivalence, corresponding to exchange value, is often based on the 'appearance' rather than the 'essence' of an object. This distinction is related to its shift from symbolic to sign value status. For Theodor Adorno, the difference between 'essence' and 'appearance' entails the ideological effect of reification. (Adorno 1973: 95) For behind the reified appearances lies the nature of commodity production. Social conditions of capitalist production restrict the forms of musical thought and action. In most cases, people adapt to these conditions rather than oppose them or question their validity.

Similarly, Adorno's attraction to avant-garde music and art, particularly the music of the Viennese atonalists, was motivated by a desire to see avant-garde works defy the homogenizing effects of commodification, where music objects are reduced to exchange value criteria. (Adorno 1984: 155) Subjectivity is of little importance as an exchange value. It plays the mere role of being just another object in the exchange. Adorno desired to preserve the subjectivity embodied in a work of art, thus protecting it from being stripped of all value, excluding exchange. He praised difficult art and philosophy since in his view, the struggle to comprehend and understand an art-work is necessary to ascertain its intrinsic value. (Adorno 1984: 155) The strength of modernism in the twentieth century reflects this strategy of resistance to overt marketing systems. The ultimate failure of modernism in the twentieth century may be linked to the same strategy. Complexity became essential for a work of art not to fall prey to commercial conditions. Another method of resisting the commercial in music was to adopt the very 'low' elements in social life: obscenity, noise, distortion, and vulgarity. Both courses of action, complexity and crudity insured that a value system surrounding the work of art would not be dominated by exchange value.

In an era where the natural object is no longer credible, the code has raised simulation and consequently reproduction to a new stature. As Baudrillard feels, in the era of simulation, not the production, but the reproduction of objects become crucial. (Baudrillard 1988: 26) Acoustic music is naturally more focused on the production thus involving the subject and object in complex and meaningful exchange. Digitally created music is mass reproduced in an exact form before it is heard in many cases. The origin of the work and any associated contexts implied in its creation are undermined by its simulation and commercialization.

If capitalism is a society in which objects have now become the goal, exchange is merely a means. If individuals treat each other as objects and treat objects as the subject and the production-distribution-exchange-consumption circuit does not allow for any sustainable symbolic representation, digitally produced music is faced with the challenge of finding a

source outside this exchange relationship if it is to establish a symbolic framework of value. As we can see there are now attempts being made to discover new symbolic associations, hybridity forms drawn from 'exotic' cultures, ritualized musical forms drawn from modern and ancient spiritual movements, and the allure of cultural fashion have all become important paths searching for a new framework.

The logic of fashion leads into another realm of value for digitally produced and exchanged music, that of the sign or status value. While many objects possess a utilitarian aspect, what essential to them is their capacity to signify a status. In a wealthy consumer society objects are produced and bought less to satisfy a need than to signify a status. Life style and status, not economic need, lie at the base of social life. This is particularly true of art objects, including music. The concert hall is much about a social gathering around shared class values, opulent buildings and 'beautiful' melodies create the environmental setting for symphony orchestras and its predominantly educated and relatively affluent patrons. The grungy, loud and raucous environment of the alternative rock or rap club is the parallel setting for the rebellious and anti-social youth. In many cases the participants in these settings are not a uniform social make-up. Participants may be from outside the primary audience culture but may demonstrate a desire to be connected with the social strata through an association with its music. This may be a factor in determining who attends live performances, buys a CD, or downloads a particular audio file. The so-called 'new music ghetto' in the classical music field is a designation of a tightly homogenous group of listeners that share a similar sign value of music.

The digital object as sign, subjected to constraints of a commodity and exchange value system, to status identification, and temporal cycles of variations of fashion is destined to be shaped by these forces and prohibited from acquiring little symbolic and intrinsic meaning. As Malcolm Budd states,

> The significance of music as an art-form has often been thought to derive from the fact that some or all musical works are symbols of states of mind or character, attitudes to life and other kinds of extra-musical phenomena. (Budd 1992: 104)

Budd aims to identify an art-work's artistic value isolated from the other values it may possess. His proposal is that the artistic value of a work of art, its value as art, is determined by or is a function of 'the intrinsic value of the experience the work offers.' (Levinson 1994: 94)

The artistic value that Malcolm Budd identifies is part of a complex system of traditional aesthetic and symbolic associations that involve the potential for representation of some quality beyond its structure or use and sign value. There are a variety of symbolic associations of a work from the perspective of creator and performer. For the composer, these may contain organic and structural principles, originality value, influence value and performance value. For the listener, there are a large number of experiential values to be considered, each individual formulating them differently. These are all dependent on a system of valuation that places symbolic associations in a higher regard than those of use, exchange and status.

Digital music, by nature of its iconic representation, is at a distinct disadvantage to acoustic forms in cultivating a rich symbolic and artistic system of value. Its use and proximity to the other forms of represented information in modern society, the highly controlled and processed media and the commodity market place, implicate it with an environment governed by non-symbolic logic. Digital music has very quickly adopted elements of strategic consumption, an essential element ever present in the world of commodity exchange, fashion trends, media and marketing, status social associations, conformity and simulation. Its significance apart from these entities will only be understood in a measured distance from them. This process for making and distributing music must identify an existence not solely as an object, but as a mechanism for a new subject-object interplay and as a symbolic vehicle for a return of new levels of ambiguity,

ambivalence, and as a language of silence, inarticulateness, the almost imperceptible creating a new tradition of self-awareness and a sense of magnitude and being.

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How Many Ways Can You Mix Colour? Young Children's Explorations of Mixed Reality Environments

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Abstract

How do we conceptualise and design mixed reality environments (MREs) to support creative play? Here we describe a first pass at a conceptual framework and use it to design a MRE for young children to explore in, focussing on the familiar activity of colour mixing. Different set-ups were provided, where paint or light colours could be mixed, using either physical tools, digital tools or a combination of these. The paper describes how children collaboratively discovered creative ways of using the mixed reality spaces for colour-mixing.

1. Mixed Reality Environments

Recent advances in the design of interactive technologies have allowed the possibility of designing 'mixed reality environments' (MREs). Drascic & Milgram (1996) offer one description of them: "Between the extremes of real life and Virtual Reality lies the spectrum of *Mixed Reality*, in which views of the real world are combined in some proportion with views of a virtual environment" (pag. 123).

From a theoretical point of view we can consider a potential distinction as being that between: (i) the real world where spaces and artefacts are acted on by conventional physical actions and where the user's understanding is, therefore, in terms of general causal models of the world and (ii) the 'virtual' where a different, and as yet little-understood, set of causal models operate and action is arbitrarily coupled to the properties of the perceived world. However, we now also have the possibility of extending the ontological profusion of worlds and objects to include environments with pervasive computing properties, building artefacts that have embedded digital intelligence. To some extent such objects have properties of both the former two. This raises the question of how people will deal, not only with the virtual spaces that Drascic and Milgram describe, but with MREs that combine real, virtual and ubiquitous forms.

To approach this question requires a mix of theoretical and empirical work and this paper will attempt both of these tasks. Minimally, we need a terminology/taxonomy that allows us to describe acting in and on these forms and we offer a beginning set below. But we also need to link this to appropriate empirical work, to see how far these concepts have utility and whether they can be useful for future design of MREs. Here we describe a MRE for young children, designed to exemplify and investigate the possibilities suggested by our taxonomy.

2. A Taxonomy for MREs

We conceptualise a mixed reality space in terms of a basic construct of *transforms*. By this we mean changes in the state of the world. People encounter, and represent, transforms between states of the world routinely in everyday life, for example in perception (e.g. seeing an object disappear and then reappear or changing one's viewpoint), in action (e.g. when the purpose of a gesture changes) and in cognition (as when we re-represent and re-interpret the state of the world). Dealing with transforms will involve some implicit or explicit theory of what causes changes of perceptual/cognitive states, i.e. some sort of causal link is usually involved. Transforms are a constant feature of ongoing perception and cognition. For this reason we propose the additional term *transform type* to identify the different kinds of forms involved, viz the real, virtual and digitally-enhanced trio identified above. For our purposes, however, we will use the term 'physical', rather than 'real', in this paper to allude to actions/activities/effects which do not involve virtual/digitally-enhanced artefacts. For the latter we shall use 'digital' as a cover-all term.

3. The Chromarium

In order to instantiate these conceptual distinctions we designed an MRE for young

children as part of the Equator project (http://www.equator.ac.uk). Our goal is to create a particular form of a mixed reality space that enables children to experiment and play across different media and representations. In particular we wish to demonstrate something of the unique properties of the digital to enhance the physical by offering certain kinds of external cognitive support (Scaife & Rogers, 2001). The chief objective in the design of the present MRE is to get children to both experience and reflect upon their interactions, allowing some hypotheses about their conceptualisations of these environments. At the heart of our design was the need to exemplify a variety of transforms, based on the combinatorial possibilities of real, virtual and ubiquitous forms.

To this end we developed an activity space, called the Chromarium (a space where colour may be contained, observed and experimented on). It was designed to enable children to carry out a *familiar* activity – that of mixing colours – in a variety of familiar and unfamiliar reality modes. The rationale for using familiar/unfamiliar as an organising concept here is that it should reflect experience and, consequently, that unfamiliarity should provoke reflection, by the child, on what is involved in its experience.

The core activity was centred around discovering and experimenting with mixing colours.

The Chromarium was also designed to enable the children to experience the different effects that occur when mixing colours using different media, i.e. using paint or light. Mixing lights causes different effects to mixing paints (for example, mixing all three additive primary colours using lights produces white, whereas mixing the primary paint colours (subtractive primaries) produces a brown-black colour.

Thus, in all cases the identity of the transform remains constant: colour mixing (although the particular form of this will obviously vary). What we do here, however, is to alter the transform type, in the sense described previously. Four types were set up, labelled according to the mechanisms involved. It is important to realise that we are referring to the *mechanism* which potentiates the transform. Thus a 'digital action' (like using a painting program on a display screen), inevitably involves some degree of physical action on the part of the user, but it is the (digital) mechanism that allows this that is crucial here.

Physical to physical transform *(PPt: action and effect of same kind)*

Here we set up two forms of PPt. The first involved mixing paints, the second mixing lights.

Mixing colours with paints is a straightforward physical activity: using a paintbrush, wet paints are selected from different pots and combined on a palette. It is easy to add colours but not to remove them. To mix colours with lights, torches with different coloured filters are shined underneath a perspex surface. With light, it is also easy to add and remove colours when mixing them.

Physical to digital transform *(PDt: action in physical with digitally-based effect)*

Here we used RF technology to enable physical actions to trigger a virtual effect. Two coloured blocks, having a different colour displayed on each face were built, each face being embedded with an RF tag. When a face was read by the tag reader (Tag-it), an animation (written in Macromedia Director) mirroring the colours would appear projected onto a wall. The tag reader was concealed beneath a table surface. Children were asked to mix colours selecting one side of each block. The effect would likewise appear as a digital animation, showing which colours had been selected and what colour they mixed into.

Digital to digital transform *(DDt: action and effect of same kind)*

Here we used interactive screen technology to enable digitally-potentiated actions to trigger a virtual effect. Two software tools were provided (Mixing Colours and Computer Crayons) that enabled colours to be selected and mixed in a digital space. Both involved dragging coloured discs (representing paint or light) to overlap. An interactive horizontal surface was provided using a back projection onto a table surface and mimio™ input devices, disguised as a paintbrush or a torch, were used for selecting the colours. The "paintbrush" activated the discs to move when the brush hairs were pressed against the discs on the table surface. The "torch" was held slightly away from the surface and a button on its side was pressed to activate it. In this space it is easy to add colours and subtract them once mixed in both the light and paint tools.

Digital to physical transform *(DPt: digital action with physical effect)*

Here we used interactive screen technology to enable digitally-potentiated actions to trigger a physical effect.

An animation of a two-coloured windmill was displayed on the same horizontal interactive surface. Clicking on the image of a cloud or the windmill in the animation triggered both the effect of spinning the digital windmill and, at the

same time, the spinning of a physical windmill placed nearby (mirroring effect).

4. Method

Five pairs of children, aged between 5 and 6, were asked to take part in the Chromarium study. They were told that they would be mixing colours in fun and unusual ways. The children were allowed to explore the various activities as they liked.

To get some data on their understanding, we prompted them to talk about their experience in the different set-ups, by asking open-ended questions such as: 'what do you think will happen if…?' or 'How do you think this is working…?'. To elicit further explanations from the children we also made use of counterfactual questions, such as asking the children to say what would happen if they tried to mix other materials (e.g. paper, fabric) compared to the effects produced by mixing paint or light. The children were video recorded during the activities.

5. Initial findings

In this section we discuss some of our initial findings. Two key questions we ask of the data are:

- Were children creative in interacting with the differing activities?
- Whether their behaviour and comments showed evidence of discrimination related to the different colour transforms and mechanisms enabling them.

Our findings showed that children were able to collaboratively discover creative ways of using the mixed reality set-ups, while appropriating the activity of colour-mixing. We observed they were particularly creative when they could freely explore and manipulate the materials provided. It was when dealing with mobile objects, like torches and blocks, that they were more active in experimenting different mixing effects or in inventing other potential uses of the same artefacts. With torches children liked to play at moving them away from the perspex surface so as to obtain larger shining effects and better mixing. When using blocks we noticed that children were trying to discover if the tag-reader surface was able to identify or capture other objects rather than just colours. Two girls for example, touched the tag reader area with their faces, expecting to see them scanned and projected on the wall, something that would have added interest to their playing and interaction with the digital world. Children also liked to mix colours by using real paintbrushes or the mimio™ ones.

Other interesting observations emerged from children's manipulation of the blocks in PDt. The children began by placing the blocks in towers to see whether anything would happen (we had not designed for this combination). They also expected digital events to happen when moving the blocks together away from the table surface. Sometimes they pressed the blocks down hard on the table surface, as if trying to amplify or speed up the feedback from the animation. Some of the children needed to enact different explorative behaviours before discovering which one of the block's faces was read and how. They tried to put the blocks against the computer screen that was behind them or against the image projected on the wall to see if any effect was coming out. They also tried to see if they could select a block's face by orienting it towards the area projected on the wall.

In DPt we observed that sometimes the children focused on the digital effect caused by the digital action and failed to notice the physical effect (physical windmill spinning). This could be due to the children's initial unfamiliarity of relating their action in the digital space to the type of feedback coming from the physical world.

The children seemed to enjoy all of the different set-ups, especially the experience of PPt and PDt. This was probably due to the larger degree of freedom afforded by the activities they could perform and to the richness of the feedback they could get from their actions, for example the combination of sounds and animations associated with their manipulation of the physical blocks. We found that activities in DDt helped the children to develop a more complex knowledge of colour-mixing, since it seemed that they were transferring their experience of the PPts to the digital space, where more complex reversals were possible (like taking a colour away of two).

Activities performed in PDt and DPt turned out to be the most interesting for children to provide causal explanations about the mechanism enabling the transforms. Their understanding of the causality involved in these transforms seemed to be affected by their actions producing effects 'at a distance' in a different space. This was especially the case when a small delay intervened between their action and the effect in the physical or digital world. When we asked the children to explain where the effect of the animations, triggered by the physical manipulation of the blocks, came from, they said things like: "the effect is coming from the computer's screen over there, and it arrives here

by means of electricity". Another child pointing first at the table under which the tag-reader was concealed, then to the projected image, then to the computer said "…connect, connect, connect…wire…it is connected under here [*table*] and goes all the way up to there!" [*PC behind him*].

Children seemed to understand there were causal links between distant objects and their actions, but their explanations were often an idiosyncratic mix of magical thought with bits of previous knowledge. For the DPt, some children did not understand that they could control in the virtual space the effect obtained in the physical world. A 6 year-old girl, for example, said that the spinning of the physical windmill was caused by the wind coming in from a window (even though no open window was available in the laboratory to justify her answer). However, two boys, on a different occasion, were quite clever at understanding causality for this effect. By looking at the windmill in the physical space they said '…this [*digital windmill*] is making that go round and round, because we are using this [*the mimio pen and the digital windmill*] …and they are connected with wires!'. They were also very explorative towards the surrounding environment when we asked them to give explanations about causality and mechanisms supporting the transforms between physical and digital space. They looked under the table to discover which device was causing an effect and how the different apparatus were connected to each other.

6. Discussion

Our findings extend the corpus of recent research on providing digitally-based play activities for young children. These have emphasised the value of open-ended forms of play for facilitating the acquisition of complex forms of thinking and acting (e.g Kolomyjec at al., 1997). The observations made in the present study support the idea that open forms of play can be well-supported by digitally augmented objects which children are free to manipulate in a three dimensional space, as representational or pragmatic devices. Of particular relevance in the present context, is how children's creativity appears to be enhanced when their physical activity in the playing world is matched to produce rich multimedia effects in a digital space.

A main finding was that children found it intriguing to experiment with colour transforms in the different set-ups provided and to reason about the mechanisms enabling the MR transforms to happen. Our initial findings indicate that children had a good causal understanding of the way the transforms worked in the Chromarium. Future research aims to investigate how counterintuitive and more complex types of effects can be designed to see if this facilitates richer causal abilities and, consequently, more elaborate forms of creativity during children's play in MREs.

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The Joy of Lists

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Abstract
The American theorist Peter Lanbourn Wilson made a useful distinction between what he called 'intimate media' and 'mass-media'. He spoke affectionately of pirate radio and of the zine or the small-scale publication as creating an intimate relationship with its audience, intimate media invites discourse. He contrasted this with speaking or writing through the mass-media which, for Bey, these forms creates no resonance, 'no returning echo'.

As the on-line mailing list invites discourse at first it seemed to exemplify 'intimate media' but there is more to it than that. If I e-mail one of the subscriber authors personally or one of the documents contain references and links to large public websites I can find myself sliding between intimacy of a personal correspondence and a mass communications domain. A powerful list is neither exclusively a mass or intimate media but something else a meta medium..A strange new social process giving rise to new content

The net as a social space.
Examples of creative pull are not only to be found in participating in the next generation of advanced tools but also on exploiting the unrealised potential of tools that already exist. Especially when this is coupled to a willingness experimentally re-deploy and re-connect basic tools to a variety of platforms, applications and networks.
The networked environment can also be seen as primarily a social space in which active relationships are pursued and deployed. A huge realm of micro-communications can be seen as the invisible street corners and cafes where the real life of the net is actually happening.

What could be described as the socialised dimension of digital media, resulting in advances in collaborative networks emerged as a direct consequence of low-cost computer mediated comminations. Beginning with e-mail but including all forms of peer to peer file transfer. But the focus of this paper is the internet's most primitive and accessible form of publishing, Mailing lists . These are easy to set up and can help to distribute information evenly and effectively to a very large or very small base of subscribers. At the same time each subscriber also the opportunity to react to the sender as well as to the whole list. "Audience" feedback here is immediate. Any one can start a mailing list. This form of collaborative publishing can take many forms; it can be tiny with just a few subscribers or extend to thousands. It can be un-moderated and open, in which case any one can join and post whatever they like. Or there can be some degree of editing or selection from the list ' owner' who might also wish to be selective about who can join. In which case, a ' closed, moderated' list, circus is a closed but unmoderated list.
But the kind of list I want to focus on here is a public list that is open that anyone can subscribe to the kind of list that evolves its discourse in public ….this represents a new form of publishing. If they are to be effective normally require some form of light moderation. Needless to say the more successful a list becomes, the more heated become the power struggles. But unlike other forms of publishing, if an individual or group feels sufficiently alienated nothing is simpler than splitting off and creating your own rival list. Like most forms of social organisation lists have to live with the paradox of the individual will to power with the need to get along together.

Lists have many limitations. We have seen from the wiki environment installed by nick that there are more adventurous forms of collaborative text filtering possible. Forms that allow us to work on each other's texts directly and also witness the evolving thread of argument without having to consult an archive. But the list has one critical advantage over other forms of net publishing which accounts for its success. It is a push medium. The material comes to the reader through their e-mail. Rather than expecting subscribers to go through the trouble of visiting a site, whenever you check your e-mail, the latest outpourings of whatever lists you subscribe to are there for you to read, save for later, or delete. E-mail remains the overwhelming killer application of the net. The fact that the texts come to you via one of your main communication tools creates a curious sense of intimacy, based on the knowledge that response and participation are just a step away. It' s as though a magazine consisted entirely of extended letters to the editor, but at any moment the editor in question might be you. All this makes ' the list' an ideal medium for groups who want to explore and develop ideas together in a critical zone hovering somewhere between the private sphere of conversation and the

public domain of publishing. Amidst all the loose talk of hybridity the list's capacity to blur private and public communications has proved itself to be a uniquely productive hybrid medium.

The American theorist Hakim Bey made a useful distinction between what he called 'intimate media' and 'mass-media'. He spoke affectionately of pirate radio and of the zine or the small-scale publication as creating an intimate relationship with its audience, intimate media invites discourse. He contrasted this with speaking or writing through the mass-media which, for Bey, these forms creates no resonance, 'no returning echo'.

As the on-line mailing list invites discourse at first it seemed to exemplify 'intimate media' but there is more to it than that. If I e-mail one of the subscriber authors personally or one of the documents contain references and links to large public websites I can find myself sliding between intimacy of a personal correspondence and a mass communications domain. A powerful list is neither exclusively a mass or intimate media but something else a meta medium..A strange new social process giving rise to new content.

http://www.net-congestion.net/

http://www.nettime.org/
Nettime
As a case study I want to take list of which I am a founder member. The list is called Nettime. Over its six year life span I have been a continuous reader and modest contributor. Although its centre of gravity is the mailing list. It has a widely consulted on-line archive, publishes a variety of printed matter, holds exhibitions, and creates conferences. It has distinguished contributors from world renowned science fiction writers to leading academics but a healthy array of…. Founded in 95 we were well into the first phase of the cash cow euphoria that later became dot.com mania. The list began as a deliberate European dialectical opponent of the libertarian economics propounded by wired magazine which was later described as the Californian Ideology. But it was also in opposition to the ….quote…
Needless to say the list attracted a lot of American subscribers and the early polarised critiques have become more subtle.. One of the most interesting contributors is the sci-fi writer and journalist Bruce Sterling.

He provides my first example of the list's influence and hybridity when he posted the following message.

********DESTROY MONEY FAST!********

sci-fi Paperback Wants to Be Free

Dear nettimers:

My publisher has just surprised me with a great whacking crate full of the paperback release of my latest novel, HOLY FIRE. This happens to be the first (and probably only) commercial science fiction novel to be heavily influenced by Nettime. It's all about European hipsters doing peculiar things with computer art - in the 2090s. The heroine is a wannabe digital art photographer.

Nettimers in the USA (HOLY FIRE), Britain (HOLY FIRE world first edition), Italy (FUORO SACRO), and Denmark (HELLIG ILD) already have commercial access to this book. Still, it pains me to think that there may be denizens of Deep Europe whose lives are untainted by Yankee cultural imperialism. Do you like to read weird, slangy English? Are you into free cyberpunk novels? Send me your snail-mail address, and I'll ship you a copy gratis. Just consider it my heartfelt recompense for all those megabytes of free Nettime theory jabber. First come, first served. Quantities are limited.

Bruce Sterling, Austin, Texas, USA

I would like to dedicate this gesture to Professor Timur Novikov of St Petersburg's New Academy of Fine Arts, a gentleman with a profound understanding of the cultural dynamics of potlatch.

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So here we have the net fulfilling its potential for enabling new forms of content to emerge from new social processes. A strange process whereby an obscure bunch of European intellectuals create an alternative discourse on the net, filtered by a mainstream Sci-Fi writer into the popular culture of airport paper backs. And then as the readers respond to the book's contents the ideas spin back into the list. The influence moves in both directions. It is not only the book that is influenced by the list but also the list perceives itself and acts differently when its influence becomes visible in other media. Over its lifetime these crossovers have occurred many times.

Another notable example occurred when one of nettime's founders Geert Lovink's attack on an editorial in Wired Magazine's Push Media was posted on the list and immediately picked up and reported in LA Times, signalling that net criticism was impacting way beyond a few academics and net theorists in Europe. It also allowed us to see that the net does not destroy the power of traditional media rather it re-configures it, suggesting that the time has come to move on from the dominant metaphor coined by J.G. Ballard, of the 'media landscape', to the more complex and speeded-up image of a media ecology.

Two year ago the Nettime list published a book. Called Read Me.
The power of established media to disturb new media was nowhere more apparent than at the book launch in Rotterdam at the DEAF. A fair spread of contributors

were present, people I knew as writers but had never met before. The editorial process of selection, that the finite nature of book technology demands, had clearly wounded many egos. The atmosphere of resentment was palpable; many questioned the wisdom of putting out a book at all - the price was to high - introducing a whole raft of dilemmas simply not present in its internet form. But it was an interesting reversal of Mcluhan's dictum that old media become the content of new media. In this instance a reversion to the book form had caused profound changes to the way an Internet list was functioning and as far as Mckensie was concerned, far from being a reason for regret. It was these very frictions and probings that had always separated Nettime from the rest of the pack.

Something personal
Nettime was my introduction to the full power of the net. And over the years of reading and occasionally contributing it has introduced me to new forms of intellectual intimacy. Despite its imperfections I believe it to be a genuinely utopian model for creating a viable online gift economy. It has also affected the ways in which I read in general, something that I am only just beginning to understand. Theorist and critic (and Nettime contributor) Lev Manovich has suggested that the computer is currently projecting its own ontology onto the culture at large, the ontology of the 'data base' which he sees as a rival to narrative with its pre-ordained trajectories of cause and effect. Certainly I have noticed weird changes in my own reading patterns. For one thing, I've become addicted to textual coincidence and more likely to spin out strange patterns. But at the same time, more inclined to reflexivity about my own position as reader or writer in this endlessly re-configuring web of connections.

I'll take one example which is base around the legendary travel writer and novelist Bruce Chatwin's book Songlines. The central thread of the book is Chatwin's re-telling of the Australian Aboriginal creation myth. Of how the legendary beings known as the Ancestors created themselves out of clay and began to walk across the continent. As they walked they sang out the name of everything that crossed their path - birds, animals, plants, rocks, waterholes: 'singing the world into existence'. Each Aboriginal inherits his own Songline or Dreaming track. 'Dreaming tracks laid over the land as ways of communication between the most far flung tribes. A song he said was both a map and a direction finder. Providing you knew the song you could always find your way across the country. '(...)'The whole of Australia could be read as a musical score. There was hardly a rock or a creek in the country that could not or had not been sung.

One could perhaps visualise the songlines as a spaghetti of Iliads and Odysseys, writhing this way and that, in which every episode was readable in terms of geology'. In the middle of Bruce Chatwin's book Songlines which describes his journey through the Australian landscape, myth and culture, there is a small incident in which the author meets Joshua, an aboriginal story teller (pintupi) in the outback. Joshua describes the rocks in the landscape as 'fire, spider, wind, grass, porcupine, snake, old man, two men' etc. At the end of their encounter Joshua tells Chatwin what, in my opinion, turned out to be the strangest story of all.

Aboriginals, when tracing a Songline in the sand, will draw a series of lines with circles in between. Each line represents a stage in the Ancestor's journey, usually a days march. Each circle is a 'stop', 'waterhole', or one of the Ancestor's campsites. But Joshua's story of the 'the Big Fly One' was beyond Chatwin's understanding.

It began with a few straight sweeps; then it finally ended in a series of wiggles. As he traced each section, Joshua kept calling out a refrain in English, 'Ho! Ho! They got the money over there.'

As Joshua's story develops it becomes clear it was a Quantas Dreaming (Quantas is the Australian national airline), and that Joshua had once flown to London. The maze was London's Heathrow Airport. The wiggles were twists and turns, the journey of the taxi from the tube station to the hotel. But Joshua's real destination was Amsterdam. The ideogram which Joshua drew to represent Amsterdam totally perplexed Chatwin. There was a circle. And there were four smaller circles around it, and there were wires from each of the circles that lead to a rectangular box.

For inhabitants of the Netherlands the four circles would be less mysterious than they were to Chatwin, they presumably represent the four large central canals that underpin the city's radial structure. But the box remained mysterious until later in the story. It emerged that Joshua had been one of four participants in an event, which Chatwin mistakenly thought was some kind of round table conference. Apart from Joshua, the other participants (drawn in a clockwise direction) had been 'a white one, a father one, a thin one, a red one, a black one, a fat one'.

The picture which Chatwin pieced together, and which he could not begin to say whether or not it was true or false, was of a 'scientific' experiment at which an aboriginal had sung his dreaming, a catholic monk had sung a Gregorian chant, a Tibetan Lama his mantras and a native African his tribal chants. The chapter ends with Chatwin writing that: 'The episode struck Joshua as so unbelievably funny that he had to hold his stomach for laughing'. As did Chatwin.

As I read this I was thunder struck. Of course!

The performance artists Marina Abramovic and Ulay had held an event in Amsterdam's Carré Theater called Positive Zero, in the early 80s (Songlines was published in 1987). In this project the artists had brought together in the Carré (now clearly identified as the mysterious box in the drawing) the monks, lamas, Africans and Australian aboriginal described in the dreaming. Incredible! An avant-garde event held in a

western metropolis had become an aboriginal dreaming. And had then been unknowingly transformed and reintroduced into the bloodstream of western popular literature through Chatwin's best seller, Songlines. The genealogy of this event is a fantastic illustration of the Alice in Wonderland culture we inhabit. The scrambling of time zones and borders. The apparently seamless travelling from the complexities of pre-historic cultures to the esoteric avant-garde and then on to the pop culture of best-seller lists and resting, for the moment here, where it has momentarily morphed into a streamed lecture for CIRCUS and later on ou website and also on Nettime. If this story starts a new discussion thread on the list, then on it will continue to spin, criss-crossing our networks.

But the reflexivity I spoke of forces me to see that I am also in a fools trance, Kidding myself that I'm in a new world of cultural diversity instead of being just another cultural tourist. The latest victim of what Stuart Hall described as the problem of 'decenterings which originate from the centre itself!' 'Have you ever thought' he wrote 'that it is only in the centre that you can really sample ethnic cuisine? In the periphery they just want people to eat, they don't have any choice, the choices exist here'.

But despite and because of my privileged position this remains an utopian reading moment. Chatwin hadn't understood the story being told, he knew he hadn't understood it, but still, he included it. And because of this, he opened up a space for me, the reader. In Practice of Every Day Life written in the 1970s De Certeau described this specific kind of reading pleasure (which he calls tactical) '...the thin film of writing becomes a movement of strata, a play of spaces. A different world (the reader's) slips into the author's place. This mutation makes the text habitable, like an apartment. It transforms another person's property into a space borrowed for a moment by a transient. Renters make comparable changes in an apartment they furnish with their acts and memories....' This tendency to open up reading spaces, rather than simply consume texts, to briefly occupy and to make them ones own, is, as I have described, a possibility in all forms of reading. But the power and the point of a skilfu lly moderated internet list like Nettime is that this quality is grounded, amplified. As you read, you know you can also respond, and that this response will be filtered through a multitude of sensibilities. A nettimer coined the term 'collaborative text filtering' for this process.

As a reader, even if you never respond, the knowledge that you could, profoundly alters the reading experience. As internet lists evolve we see new forms of content emerge from what is essentially a strange and often dysfunctional social process.

The Way Forward

Like all of us the internet has the defects of its qualities. . The decentralised nature of the net means that the really interesting cultures being created on the Internet are difficult to locate and remain largely closed off from one another. The problem is well described the 1998 essay *Public Culture*, in which Jurgen Habermas describes a situation in which communications technologies have both expanded actors' consciousness and provided for differentiation, extension and interconnection of systems, networks, and organisations.

Although the growth of networks and systems have facilitated exchange of information and multiplied possible contacts, he argues that the publics produced by the Internet remain closed off from one another. He asks, "What kind of larger public consciousness can span the differentiated contexts created by electronic political communication?

As his background is as political theorist he would be unlikely to look for a solution to the problem in the domain where it is most likely to arise. In the technical domain. The systems are proliferating at such speed and are so complex that only machines will be able to keep up. If we want the net to allow for a larger public consciousness that span the differentiated contexts space then a net must evolve in which documents are not only readable by people but by machines. And we Artists, designers , writers must align themselves to what Tim Berners Lee and others have termed the semantic web.

Interesting projects for meta tagging for lists are already underway.

I want to draw your attention to theOpen Groups www.opengroups.org

is to help people to search, locate, evaluate, and join ongoing interactive public groups across the Internet through the development open standards that can be used to describe online groups.

Open Groups is a proposed initiative that provides an extensive opportunity for the involvement of universities, companies, non-profit organisations, Internet standards groups, foundations, and individuals interested in establishing a trusted, vendor-neutral, initiative to develop, implement, and support the purpose of Open Groups.

Over time, it is envisioned that a basic standard will be adopted to describe ongoing public online groups. This includes e-mail lists, web conferences, news groups, chat, and other online places where ongoing group interaction and information sharing of a many-to-many nature takes place.

Online groups can easily be described by a core set of standard metadata fields with additional fields connected to each type of interactive space. However, the weight of interests involved in all interactive space formats calls for an incremental approach.

It is about creating standard ways to describe groups that can be integrated in to online interaction hosting software and systems and the exploration of models and mechanisms for the wide sharing or syndication of metadata on public groups across the Internet in order

to foster the competitive creation of up-to-date, advanced and useful directory sites.

As a test of concept, the first step this draft set of possible description fields about e-mail-based group lists. Developing a standard list of metadata fields to describe e-mail lists (which the appropriate use of XML and other standards) should spur reaction and broad interest in the effort among the hosts of online groups, particularly those who design or sell group/list software, and major directory services on the Internet.

Aquitanian Chant Notation: a Web-Based Tutor

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Abstract

The chant notation tutor to be demonstrated in this session has enabled the study of early chant notations to enter the undergraduate curriculum. This tutor is not only the first to appear in an electronic medium, but it is also the first to appear in the English language.

1. Introduction

Throughout the 1990s, the Department of Music at The University of Glasgow developed a strong area of research and teaching in Music Technology under the direction of Dr Stephen Arnold (now Professor of Music at Kingston University, Surrey). In addition, a combined course in Music and Electronic Engineering was planned and implemented. Fortuitously, the 'Calliope' computer programme for editing early music (including chant), designed for NeXT computers, was concurrently produced by Dr William Cloxin at the Cambridge Computer Laboratories (England), and our own Music Department was supplied throughout with NeXT computers. All this created an excellent environment for creating computer packages under the *Teaching Information and Learning Technologies (TILT)* project for courses in the undergraduate curriculum.

This paper will demonstrate the use of a computer-teaching package with interactive exercises on transcribing eleventh-century Aquitanian chant notation within a general undergraduate course on music notation. This course is a prerequisite for those who wish to embark on an edition in their final year.

The first package, for NeXT computers, was produced under the *TILT* project, authored by Greta-Mary Hair and Celia Duffy, who designed and implemented the computer interactive exercises using 'HyperSense', and it was used for the first time in 1995. This area of study, formerly considered appropriate for postgraduates, is now taught at Glasgow within the undergraduate curriculum, and it is interesting to record that the first pedagogical tutor is in English and produced in an electronic medium. The only English text known to us which offers excellent details concerning the notation and which, if studied carefully, would enable one to transcribe, is the PhD dissertation by Cheryl Crawford Frasch (State University of Ohio, 1986). I also mention that the late Dr Isobel Woods-Preece, from the University of Newcastle, was the first musicologist in the UK to introduce undergraduates to the study of Aquitanian chant notation. I had invited her to comment on the package, and shortly before her untimely death, she had expressed her interest and enthusiasm to do so.

Manuscript facsimiles of short Introit and Communion chants (where psalm verses and Gloria Patri Psalm tones are invariably abbreviated) are ideal for a computer screen. One is able to view the entire structure of these chants without having to scroll. The facsimile folio on which the package is based comprises the last part of a Prosula, a final Offertory verse, a Fraction Antiphon, a Communion with Psalm verse notated in full, and the first part of an Introit for the following feast. The interactive exercises are based on excerpts from this folio.

2. Web-based package

Since 1995, computer technology has advanced and NeXT computers are no longer available. The present, revised and expanded version of the package is authored by Greta-Mary Hair together with John Gormley. It is implemented using Java Applets, HTML and Javascript and is available over the internet. It was used for the first time in 2001. Five lectures are allotted to cover chant notation. The students are advised to work frequently through the package and "drill" themselves in the basic fundamentals covered in the lectures.

3. Exercises 1-17: Recognizing neumes and intervals

10 require the identification of individual neumes which are multiple choice exercises.
1 tests the student's judgement in measuring the intervals.
2 require the matching together of neume-names with the neume characters.
4 multiple choice exercises within this group require the student not only to identify certain neumes correctly, but also to identify their significance or function.

3.1 Exercise 1 (Fig. 1) begins with the identification of the simplest neume placed on the dry point line, the latter visible in the original manuscript and on a good facsimile, but made made visible on the screen by simulation.

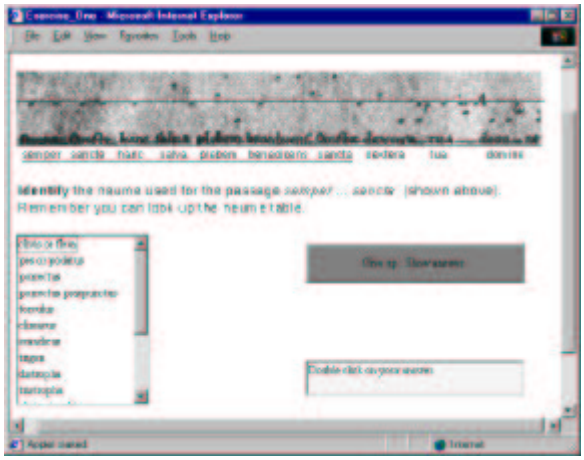

Figure 1: Exercise 1

The exercise shows a section of the facsimile, instructions, a list of neumes, a *Give up* button and a feedback box for additional instructions and feedback.

From this opening screen, there are three possible outcomes, the student:

1) selects the correct answer
2) selects the wrong answer
3) gives up

If the student selects the wrong answer, the neume list disappears and a message is displayed in its place. In addition, a *Try again* button appears below the existing *Give up* button. The neume that the student selected is displayed in the feedback box to cover the possibility that the student may have forgotten which neume was selected.

At this stage, there are two possible ways of moving forward. The student can give up or he/she may try again. If the student clicks *Try again* then the screen is returned to a similar state to that above (Fig. 1). The only exceptions are that the feedback box will say "Try again" and the neume which the student had selected last time is removed from the neume list to narrow the choice.

3.2 Exercise 3 (Fig. 2) tests the student's judgement in measuring the intervals between pitches in relation to the simulated dry point line.

The design of this exercise is considerably more complicated than that of Exercise 1. You will observe an annotated facsimile, instructions, 14 answer boxes into which the student can enter intervals, two buttons and a feedback box.

Before the student is able to check the answer, he/she must first enter an interval into each of the answer boxes. There are a number of issues here. First, the exercise has been designed to prevent the student from entering anything other than one digit into an answer box. Second, when the student clicks on an answer box, the associated annotation on the facsimile is highlighted in blue.

When the exercise has been completed correctly, and the student checks the answers, the buttons disappear and the feedback box offers congratulations. If some intervals are wrong, the feedback box will show how many are correct. At this point, it will not be possible for the student to alter any of the intervals that are correct.

Figure 2: Exercise 3

If the student gives up, the correct intervals are displayed below the answer boxes. Intervals that are incorrect will be highlighted in red. By doing this, the student becomes aware of the intervalic distances he/she finds awkward to calculate.

3.3 Exercise 7 (Fig. 3) displays two extracts from the facsimile. Each neume on the extracts is connected to a red label-box. The student has to identify each neume on the facsimile by dragging the neume-name from the neume box (Fig. 3, bottom left) into the correct red label-box.

Given the number of choices we have allowed the student to check the answer in progress. The label-boxes that contain correct neume-names will turn blue when the student clicks *Check Answer*. Thereafter, it is impossible to move neume-names that are in their correct boxes.

To avoid confusion, only one neume-name will fit into a label-box and any neume-name that is dragged to an illegal position will be returned to the neume box. This is to prevent a student from irretrievably dragging a neume off the screen or dropping one behind a button.

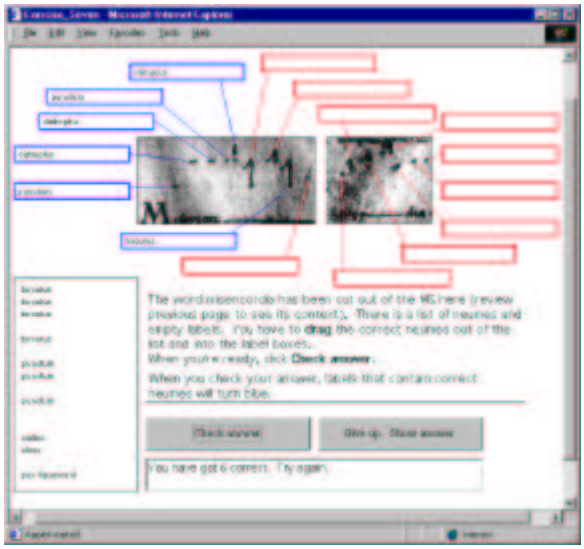

Figure 3: Exercise 7

3.4 Exercise 12 (Fig. 4) is a multiple choice question which has been implemented via a set of buttons. When the student clicks an answer, the three buttons disappear and an appropriate message is displayed. Following on from this, the student is asked a further question, "Does this neume character have the same significance in other MSS?" Two additional buttons are displayed: *Yes* and *No*. When the student answers the second question, the new buttons disappear and a message is displayed.

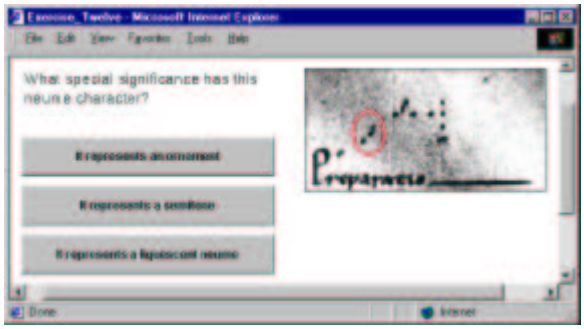

Figure 4: Exercise 12

4. Exercises 18-24: Recognising modal Psalm-tone formulas (Fig. 5)

It is necessary for the students to memorise the eight modal Psalm-tone formulas in order to identify the mode of an Introit or Communion from the 'Seculorum amen' - the termination of the 'Gloria Patri' given in the manuscript at the end of these chants. This melodic fragment is called the 'differentia' and also functions as an abbreviation for the 'Gloria Patri'.

After clicking the *Play* button and listening to the Psalm-tone, the student must enter the mode and reciting-tone into the answer boxes. The box for the mode allows the student to enter a digit between 1 and 8. The box for the reciting-tone allows the student to enter the characters A, B, C, D, E, F, or G. The entry may be made in upper or lower case.

The feedback box tells the student whether

1) both mode and reciting tone are correct, or
2) one is correct and which one is correct, or
3) neither is correct.

If the student gets both correct, or clicks *Give up*, then the buttons (Fig. 5, bottom left) will disappear and the feedback box will display an appropriate message.

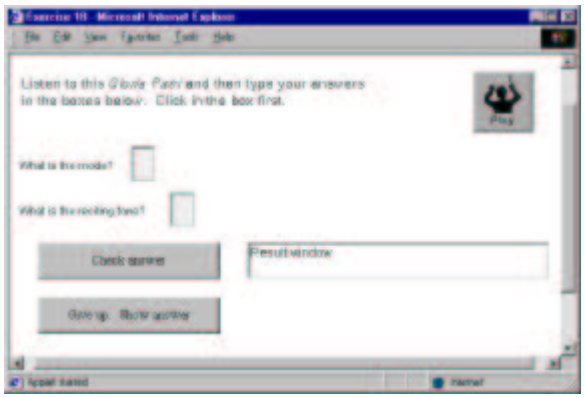

Figure 5: Exercise 18

5. Exercise 25: The differentiae (Fig. 6)

The last exercise tests the student's knowledge of the Psalm-tone differentiae by requiring him/her to link the Psalm-tone incipit with its termination or differentia.

The original idea for this exercise was to allow the student to match the incipits with the differentiae by dragging the incipit graphic to its standard differentiae. However, it was felt that this would require a considerable amount of screen space and be difficult in practice. The solution shown below was most successful. By keeping the incipits in the left column and the standard differentiae in the right

column, the student is able to drag a line (called a "tie") from each incipit to the little box to the left of the corresponding differentiae.

This solution maintains a gap between the incipits and their differentiae which also implies that there is melodic material between the two.

Figure 6: Exercise 25

The buttons and the feedback box work in the same manner as in previous exercises. Some additional features have been added to the exercise to make it easier for the student. The ties are "magnetic", that is to say, the student doesn't have to click directly on a tie but only nearby. The tie will then jump to the mouse. Likewise, the student doesn't have to drop the tie exactly in the middle of the square box to the left of a differentia. If the student lets go nearby a box, the tie will jump into it.

Like the exercise on dragging neume-names, only one tie will connect with a box. Furthermore, a tie will return to its incipit if it isn't put into a box. This prevents the student from dragging the ties off the screen or behind buttons where it would be impossible to retrieve them.

6. The Function of the package within the course

Each week the students are also required to transcribe and attempt to reconstruct an Introit or Communion chant. By frequently working through the package and memorising the Psalm-tones by singing them repeatedly, each student will be drilled in the basic fundamentals. Lectures three and four provide a method for assigning mode to other chants, for example, Graduals, Alleluias, Offertories, and their verses, which have no melodic modal formulas attached to them, like the 'Seculorum amen' which instantly allows one to decide on the modal assignment of an Introit or Communion.

The modal assignment for these other chants involves more complicated procedures. The mastery of the basic fundamentals is essential in order to proceed to the projects for assessment. The package is, therefore, an aid, and is not intended as a substitute for lectures.

* * *

Earlier demonstration: International Congress on Medieval Studies, Kalamazoo, 3 May, 2001

Future possible networking: via TEAMS: [The Consortium for the Teaching of the Middle Ages], Catalogue 2001 (Kalamazoo, Medieval Institute Publications, Western Michigan University)

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Submission to *Circus 2001.*
Conference Theme: 'Interactivity and the Future of the Creative Practice': 'User Interfaces and interfaces extensions to support creative processes'

"Streaming sensor driven Midi - triggering remote interactivity",

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Abstract
In recent years there has been a rapid upsurge in the use of digital audio in art installations and web-based events. There has been a development from the simple use of sequencer hardware and digital audio files, to relatively complex implementations involving the use of multimedia, interactivity, sensors, and webcasting. One aspect that has tended not to be explored is the streaming of 'live' midi data over the Internet, and its role in interactive composition.

This paper is based on in-depth personal experiences in this field, and discusses issues and findings important to advancing the use of this leading edge technology in an arts and interactive context. The installation work discussed involves the use of the I-Cube sensor interface system, midi data generation, and 'live' Internet streaming of midi data. In particular, the solar eclipse 'Totality G2V 2:23' event (http://www.agraphic.co.uk/eclipse.htm) on August 11th 1999 is discussed.

The paper is likely to be of interest to digital audio artists, sonic art musicians/composers, researchers into innovative creativity, webcasters, arts event/installation organisers, multimedia artists, and multimedia web designers.

Introduction
In recent years there has been an ever-increasing amount of activity in the use of digital audio in art installations and web-based events (Solina 2000). There has been a development from the simple use of sequencer hardware and digital audio files, to relatively complex implementations involving the use of multimedia, interactivity, sensors, and webcasting (audio and video 'broadcast' over the Internet). Many exponents of sonic art make conceptual, and often physical, links with the science of 'the earth' and/or 'nature' in the process of creating sounds (Voegelin 2001). This paper discusses the experiences of experimenting with a custom built midi-sensor interface, introduces how generated midi data can be streamed over the Internet to form a networked creative event, and illustrates how this innovative interface uniquely contributes to the creative process.

In August 1999, the Totality G2V 2:23 project culminated in what has been described as a 'world first' - the live 'streaming' over the Internet (in real time to numerous connected composers) of midi data - and in this case directly generated by solar eclipse phenomena. An important feature of the event was the use of a specially constructed 'probe' to sense changes in heat and light - with conversion of the measurements into midi data. The

paper describes the technology associated with this unique groundbreaking experiment, and its relationship with the creative process.

Background

The Internet is host to an increasing amount and scope of arts based activity (URL No.9; Donati & Prado 1999; URL No.10; Lawrence *et al.* 1998) - in many ways the presence and experimentation of artists on the Internet has significantly advanced developments in how multimedia artifacts and technology are utilised, handled and networked.

Collins (1998) discusses the possibility of using the Internet as a tool for jazz educators - using MIDI and A/V streaming technology. Barrett (1998) describes a 'plug-in' (for Realmedia - URL No.13) which has midi/audio streaming capabilities; the emphasis being on synchronisation of archived audio and midi material.

Beckstead (1996) explores the use of new technologies that enable young composers to exchange ideas and music electronically; describing two collaborative music projects involving telecommunications and MIDI: Composers in Electronic Residence (CIER) and the Computer Music Project, which originated in Oldenberg, Germany. Metlay (1996) discusses ways that musicians can meet fellow artists and collaborate (e.g. by exchanging MIDI files) through the Internet. Povall (1997) investigates the effect of electronic technology in general, and wide-area networks in the specific, on music and musical practice. These are examples of how the Internet is increasingly becoming used for collaborative music composition work - but invariably involving the exchange and sharing of midi files; as opposed to the use of 'live' streaming of midi data.

In recent years there has been a significant amount of interest in the use of sensors to trigger the production of midi data following interaction with people, natural phenomena and/or physical events. One of the most widely used midi generating sensors is the I-Cube range (URL No.1). The use of this type of sensor reaches across the areas of electronic music (URL No.2; Bongers 1998; URL No. 6), dance (URL No.3), educational 'toys' (URL No.4), and therapy (URL No. 5), and others. Bongers (1996) discusses the work of Sensorband, a trio in which each musician plays a different type of controller, based on ultrasound, infrared, and bioelectric signals, respectively. The article also describes how the band performs computer music by climbing upon the cables of a web-like construction - sensors measure the tension of each cable and send corresponding control signals to synthesizers. Haken (1996) describes a unique keyboard instrument that has no keys. Instead, its continuous surface senses each finger movement in three dimensions, and makes an interpolation with stored sounds.

Lacey *et al.* (1997) identify the opportunities and problems associated with the rapid advances in audio compression technology and increased use of communication networks - and draw attention in particular to the issue of copyright protection. Paradiso (1997) discusses the introduction of digital controllers - which have had the effect of widening the scope and access to control expressiveness of synthesised sounds. Rovan (1996) provides an introduction to Max, a real-time graphic programming environment for Apple Macintosh computers - covering the basics of how to build simple Max

programmes ("patches") to alter midi data. Nelson (1996) briefly examines the use of Max to create a programme that uses input from MIDI synthesisers to generate complex number patterns and translate them into midi 'notes'.

Norman (1996) explores various aspects of the aesthetics of using sounds from the "real world" as material for musical compositions, and suggests that composers who employ this compositional technique share working methods used by artists in other fields such as poetry, film and other non-sonic art forms. Colton (1998) profiles composer Alberto Gaitan and discusses his new public art installation that creates music by attaching sensors to road bumps planted at various intervals on a 1,800-foot stretch of road. In October 1999, the ICC Biennale in Tokyo included an installation that generated audio and visuals from seismic data picked up from California's Hayward Fault (Goldberg *et al.* 1999).

Prior work with Sensor Systems

In the years leading up to the Totality project, Host Productions experimented with a variety of systems and sensor based equipment - in 1996, the first piece of work attempted with a software/midi system, was a very simple installation called POD2 (previously, analogue systems of pressure pads and tape machines had been used). POD2 was a very ambient piece involving the use of the I-Cube system (URL No.1) with a range of heat, light, proximity and contact sensors discreetly placed around the entire space of a group exhibition, the plan being to create an ambient soundtrack for the whole show that was dependent on various conditions and movements of visitors around the space. In this situation the I-Cube system was used in its most basic mode - the 'stand alone' mode. This mode of operation allows the various sensors to be mapped to individual samples or MIDI controller parameters and operates without the need for a master computer once the configuration has been downloaded into the cube.

Some time after POD2 came POD3. This installation came about through a desire to create a self-contained structure or system that would house the sensors and electronics. It was also created as a system that would be able to more accurately observe and react to movement within a space. What evolved out of these initial plans was a grid structure enclosing a space five meters square and just above floor level. Around the perimeter of the grid were eight laser diodes, each of which lined up with a light sensor at another point across the grid. Any time a laser beam was tripped by a body passing through it the sensor would send a signal into the I-Cube digitiser unit. The first evolution of this piece was very simple, along the lines of POD2, using the I-Cube in the stand alone mode, each beam/sensor combination being mapped to one sample. This proved that the system functioned but wasn't particularly exciting. To begin to make the installation more interactive and 'intelligent' it was necessary to start working with the system in 'host' mode, hooked up to a controlling computer running Max patches. (Opcode Max is an object based programming environment in which it is possible to create applications for a huge variety of MIDI based situations).

There is an I-Cube object for Max that allows the digitiser to be the front end for quite complex operations. As the creation of patches for the laser grid system progressed its

capacity for interactivity was greatly extended. In its latest incarnation the grid has multiple samples assigned to each beam. It makes its decision on which of the samples to play when a particular beam is tripped by looking at which beams have been tripped recently, which samples were played back at that time and how many times the beam in question has been tripped since a specified start time. As well as beams for triggering samples from time to time a beam will be switched over to controlling such things as program change and effects selection, again of its own accord having analysed what has gone on before. Hence the grid, once powered up, will start to learn the way in which a person moves around it and react accordingly, always throwing in a twist when the 'inhabitant' seems to be learning the process - this possibly could be considered as a form of artificial intelligence. As well as functioning as an installation in its own right the laser grid system has been used in a multi-media performance by the Spark Collective called 'Strange Attractor''. In this performance the grid is used as the stage and is inhabited by two dancers. The movements of the dancers around the space generate the soundtrack to which they dance forming a simple kind of feedback loop. A future evolution of this piece will allow the movements around the grid to control the playback of video images as well as the sound.

Having had plenty of fun with environments geared towards interactivity with people in direct relation to the environment within an enclosed space Host Productions began to consider working with larger situations - with a particular desire to work with the 'natural environment. A 'probe' system was developed which would be able to monitor certain aspects of environmental and meteorological flux. The initial prototype 'probe' was a structure that looked like the offspring of film lighting equipment and a World War 2 anti-aircraft gun and utilised two pairs of light sensors, a pair of heat sensors and an electromagnetic field sensor. This piece of apparatus could be aimed at anything and monitor the fluctuations in those conditions that arose from it. Rather than a direct event-to-sound process as in previous work this system was used to record a series of events over a certain duration as MIDI files which could then be used to control the playback of other sound material (e.g. samplers, sound/synthesiser module notes).

The aim was to build up a 'library' of sound material and MIDI file material from a variety of sources and locations and to 'cross-pollinate' them to throw up new interpretations of previously recorded situations. For example, on one occasion the sounds and resonances of a particularly intense late summer thunderstorm were recorded, and these sounds were sampled and stored. On a subsequent day the weather comprised of bright sunlight broken up by intermittent clouds. The probe device was set up to capture these sudden and dramatic light changes and a MIDI file was recorded from them. This MIDI file was then applied to the storm samples and a new sonic interpretation of the storm was created. This approach was also utilised during the total solar eclipse of August 1999.

Eclipse Installation

Alongside Jeczalid Films, Agraphic Design, Middlesex University, and friends; Host Productions staged a project during the total solar eclipse on August 11th 1999. The

project as a whole involved the webcasting of experimental solar eclipse video film, and solar sounds as well as the 'live' streaming of midi data generated by the eclipse.

The new Probe system was utilised - allowing the monitoring of certain environmental conditions using a range of sensors as part of the I-Cube system. In this instance a combination of light, heat and electromagnetic field sensors were used. The sensors were used to gather information from the environment and as the numerical representations of data came in to the computer from the I-Cube system, it was converted into MIDI files. These MIDI files would then be used to control samples in an ensuing installation and also be streamed over the Internet in real time to a collection of artists around the globe who had been invited to create compositions of their own. This real-time streaming to multiple recipients around the world appears to be the first such experiment with 'live' generated midi data.

The system was set up as follows: the probe device monitored the ambient environment and sent values based on fluctuating light, heat and EMF levels into the receiving Opcode Max program on a PowerBook computer. The Max patch received the sensor information as numerical values within the MIDI note range (0-127) and also as controller information on three MIDI channels. This data was stored as MIDI files on the PowerBook whilst also feeding the 'live' MIDI data into a PC running MidiChat software. From here the MIDI data was streamed out 'live' to the people who were set up to receive in other locations (more details later).

One of the original purposes of the development of the 'probe' system was to collect a library of this kind of environmental data while also building a separate library of sound material from the same locations and events. These two libraries would be introduced to each other in various combinations in an attempt to generate a quantity of new interpretations of the events - the 'environmental remix' if you like. The sound material for the web cast and what would form material to be controlled (in later installations) by the probe device's MIDI files was sourced from VLF radio emissions. VLF is Very Low Frequency radio signals in the 0.1 - 11 kHz spectrum. The majority of sounds audible on these frequencies are generated by electromagnetic phenomena such as lightning strikes, the impact of the solar wind on the earth's magnetosphere, and coronal mass ejections. Sounds from VLF frequencies range from crackling/popping sounds of actual lightning strikes to whistling tones of radio signals rushing through the magnetosphere to roaring, rushing sounds of solar winds and magnetic storms. These sounds were collected during the three days leading up to the eclipse using a WR3-E receiver designed by Stephen McGreevey in the US. Although the actual day of the eclipse was overcast in the traditional British style, the probe still managed to collect a huge amount of information. Despite the clouds there were still some very dynamic changes in light and heat levels, especially just before and just after totality. All together approximately 3 hours of MIDI files were recorded.

Midi webcasting technology

The Digital Creativity research group, at Middlesex University, worked closely with Host Productions to achieve something unique in the area of multimedia Internet

communications. The midi data generated by the eclipse, using the Probe, was streamed 'live' over the Internet to be available to musicians/composers all around the world - enabling them to use the data as a basis for creating original compositions simultaneously as the eclipse developed. There was an issue here - the conflict between the wish to take part in an online collaboration and the desire to directly experience the phenomena in question. Where this was the case, it was resolved by sending archived midi files to composers after the event.

There are several examples of techniques, supported by proprietary software, of working with midi in networked and Internet environments (URL No.11; URL No.12). However, our research has found that there was only one package available that supports midi streaming of 'live' data (as opposed to stored midi files) and multiple simultaneous participants. The software is known as 'Midichat' (URL No. 7), and has had only limited previous use; a notable example being the midi streaming carried out as part of the YouthMedia Conference in June 1999 (URL No. 8). It is possible for Midichat participants to each send *and* receive midi data, but for simplicity we adopted the approach of 'receive only'.

The eclipse midi data, output from the Max software running on a MAC Notebook computer, as described earlier, was fed to the 'Midichat' software (running on a PC) - 'live' as it was generated during the approach and duration of the eclipse. The connection between the computers was via a standard midi cable and interface. The Midichat software enables midi to be streamed to multiple users connected to the Internet, together with text chat between connected parties. Each participant needs to 'connect' to a specific 'channel' - rather like online chat channels. The midi data received by the participants can be relayed to internal or external midi sequencers for disc storage, and/or via sound sources (e.g. PC soundcard) for immediate listening and composition. One restriction of the software is that it is only currently available for use in the PC environment (hence the use of a PC in the streaming configuration).

The Internet connection was made via a POTS communication line (standard telephone connection) using a 56K modem card. This type of connection is quite adequate for midi streaming, as only moderate bandwidths are needed. Prior to the event on August 11th 1999, the Internet was used to identify people who had an interest in participating as musicians and digital composers (using email and newsgroups). Test sessions were also run so that the webcast team and the potential participants could become more familiar with the software, the concept of 'live' streaming and the capture/use of the streamed midi data. The number of participants was less than expected (6 active participant artists and digital composers around the world), but the effective marketing of webcast events is notoriously difficult, and is a topic of ongoing research (Lawrence et al. 1999). During the event, the use of the chat facility was suspended (as it was found to periodically interrupt the midi connection) with feedback and support provided by the webcast team using email. The streaming of the midi data was very successful; a continuous stream of the midi data was made available on the Internet for the complete period leading up to and during the eclipse event. This was a unique achievement and one of the first such experiments conducted.

By demand, a re-run of the streaming was carried out, using archived midi files, to extend participation in this unique, experimental and special event. The combination of the two streaming events has resulted in the creation of several very interesting compositions based on the midi data originally generated as a consequence of the eclipse phenomena - some of which have been published on a CD-ROM (Totality 2000).

The midi files were used soon after the Totality project, in an installation called 'Positron Array'. Essentially Positron Array was a remix of sound and MIDI data from the eclipse controlled by environmental fluctuations within an exhibition space in Manchester. During and around the time of the eclipse, numerous recordings of VLF radio phenomena had been made. These recordings were all sampled in sections and assigned to a number of different programmes. A Max patch was written which stored all the MIDI files recorded during the eclipse and parameters for the selection of which bank of samples and programme setting to assign them to. All this was controlled by another probe device hoisted up into the roof of the space to monitor fluctuations in heat and light levels dependent on weather patterns throughout each day. Various levels sent back from the sensors would select which MIDI file to play back and choose the sample bank, programme and tempo.

Impact of streamed midi

Over a period of time following the streaming of the eclipse midi data, the authors could not resist the attraction of composing soundtracks based on the data (including merging self-composed patterns with generated-midi controlled sounds). The experience of working with the data, and developing sounds driven by the pace and majesty of the eclipse event was very special indeed. One of the factors is that the pattern of sounds provides a vivid reminder of the personal impact of the physical eclipse. Others have remarked on this - to the extent that even those that did not personally witness the total eclipse are able to use the sounds to enable them to experience the 'feeling' of a total eclipse very strongly in their imagination. This knowledge helps to justify the efforts made to stream midi generated during such special natural events; perhaps especially when accompanied by visual images - the 'live' sounds contribute to enabling remote participants to more fully feel part of the event. Archives of such midi data are also important - so that experiences can be repeated and spread to those that could not participate in the event at the time.

The composition of songs relating to nature and natural events is an age-old activity (James 1993), and recently there has been a strong interest by digital composers to create pieces based on data generated by or describing the powerful characteristics of natural phenomena (URL No.14, Sound Practice 2000). The influence of nature can be conceptual, emotional and/or data driven - the use of sensor generated midi is fundamental to many of 'data driven' compositions. The 'live' streaming of generated midi offers the opportunity for composers and musicians in remote and distant locations to simultaneously, but individually, benefit from the use of often very special source data.

In one sense, the use of midi data as the foundation of a composition may seem restrictive and prescriptive. However, in the case of projects such as described in this paper, the midi data represents the fundamental encapsulation of meaning to a depth unique to natural phenomena - the Probe being the physical interface, and the generated midi data files being the interface that provides the 'feeling' and 'effect' of the event. 'Live' and archived streaming of this data enables open and repeated opportunity for composers to express creativity indirectly inspired by the event itself.

Impressions of I-Cube usage from an artist's point of view

As a sonic artist, Andy Gracie had had no real experience of computers, programming or MIDI operations before starting to use the I-Cube system. Although it felt like a positive step to begin working with much more sophisticated and complex tools than before, it was also very daunting, being aware of a whole lot of new and esoteric things that would have to be mastered. In actual fact, leaving aside the general computer skills and understanding of MIDI, the I-Cube system proved very easy to set up and use. Even with as basic a level of understanding of the underlying concepts as I had at the time it was possible to virtually plug in and play. This was partly due to the fact that the system was being used in its much simplified 'stand alone' editing mode, meaning that there was no need to get involved in complex programming procedures. The limitations of the stand-alone mode enabled a quick understanding of how a range of sensors functioned and the relationships between the data coming in from the sensors and the resulting signals from the MIDI equipment. As handy as this function is, it is only once the I-Cube system is used in its 'host' mode in conjunction with Opcode Max that its real power and versatility becomes apparent. Max is an incredibly versatile and complex piece of software, or at least it can be. Its beauty is that it can be used, to a degree, with the most rudimentary understanding, if one is only pursuing a simple goal.

The I-Cube system fits seamlessly into the Max environment, there being both 'iCube' and 'oCube' objects for control of the inputs and outputs respectively. The objects can be built into a simple patch, or programme, for mapping each sensor to an individual MIDI note number at the simplest level, to as complex a patch as you would wish to make, converting sensor information from the outside world into any number of parameters for the processing of MIDI information, video clips, relays and so on. With a certain amount of personal application and endeavour one can soon begin to create work with a fair degree of sophistication and complexity. In terms of input capability I-Cube has proved to be more than adequate, having 32 inputs. As an artist who is a firm advocate of simplicity this has always been plenty. There will always be a trade off between the number of sensors used and the amount of processing that a patch can accommodate, each sensor will put out a huge amount of information, more sensors meaning more complex patches and more demands on the CPU to deal with all the data.

Preference is to use a smaller amount of sensors to perform more functions than a huge array doing not very much. The last eight of the 32 sensor inputs can be used as outputs to drive relays, LEDs or other compatible actuators. It would be nice to be able to use more so that, maybe, each sensor input could be assigned to an output, at least in a 16 by 16 configuration.

The most satisfying aspect of using the I-Cube system for interactive work is that the system will soon become 'invisible' - almost becoming like second nature. The I-Cube itself is just something that plugs in along the lines enabling the artist to focus on the creative rather than the technical. There are always going to be a large number of artists that prefer to get right in and create a system of there own with all the electronic trickery that goes with it but this can, without care, lead to a piece of work that is about the equipment used, and not a creative concept. The I-Cube system allows a piece of work of technical complexity to be created without having to worry too much about whether it is going to work or not and without diverting too much creative energies into purely technical matters.

Conclusions

This paper has described the technicalities, organisational aspects, and interface technology involved in a unique and groundbreaking digital arts event. Practical and creative issues relating to the use of a custom-built sensor interface, generated midi, and the Internet are discussed in the context of the 'live' streaming of midi data generated by the 1999 eclipse. It is illustrated how such an innovative and dynamic interface can uniquely and powerfully contribute to the creative process.

It is planned that more such experimental use of streaming 'live' midi data relating to natural phenomena will take place - to continue the exploration of openness and collaborative features of the Internet, the creative issues relating to midi-based composition, and the use of midi data generated by natural phenomena.

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virtual Reality - tautological oxymoron - Malcolm Le Grice - 8 September 2000

For a short while one of my forms of relaxation was flying a light single engined high wing monoplane. I particularly enjoyed taking a flight around the bay area of San Francisco - around Berkeley along the Bay Bridge over Treasure Island then fly as low as I could get away with over the pyramid in the centre of the city and out over the Golden Gate into Marin County then make the circuit back over the water to Oakland. I particularly liked to do this in the late evening as the sun was going down and the lights of the city were coming on. One night I had started a little later than usual and instead of turning north over Marin I went south down the coast. After almost an hour I realised I had flown further than I intended and on impulse decided I would carry on down the coast aiming for Los Angeles. It was already past eleven, LA would still be some 300 miles away, my early Cesna could not make much more then 120 miles in the hour and I calculated I should need to refuel on the way. I reckoned I would not get there until two in the morning or even later but made up my mind to go for it. I planed to find one of the smaller airfields which seem to be all over the west coast where I could land and take on fuel. I picked one out just before Santa Barbara. As there was a light wind coming in from the east I radioed in and flew into the runway from the west. There was no beacon so I prepared for a visual landing, always a bit tricky in the dark but the lights showed the runway clearly and I approached at about 60 mph cutting the throttle and lowering the flaps watching the altimeter carefully. I still hit the ground with a bit of a bump and a bit further up the runway than I should have been but otherwise it was a good landing. I refuelled quickly, taxied to the end of the strip and took off again into the sea breeze banked steeply left and off again with the sea on my right and the foot hills of the Sierras on my left. By one thirty and still some way to go I must have become drowsy. Though I was alone in the cockpit I thought I heard Emily call out “are you coming to bed?”. Then after what seemed some time, her voice again only closer. Distracted I suddenly noticed that the altimeter reading was low. Now you may know but I did not, just before you get to LA there is a ridge of hills which seem to come down all the way to the sea. Having lost concentration I had drifted in land and lost height. In desperation I pulled back quickly on the stick without enough throttle I went into a stall and ploughed into the side of a hill. The plane ended up nose down and tail in the air with Emily standing behind me in her dressing gown - “what on earth are you up to - it’s two o’clock - I just woke up and wondered where you were”.
Sheepishly and rather irritated I said “I was flying down to Los Angeles - I wanted to see if it was there”.
“What do you mean - you wanted to see if it was there?”.
“Well I knew all the Bay Area was there and found that it seemed to continue down the coast - I wanted to see if LA was there as well”.
“But at two in the morning.” She paused, “and is it?”
“Is it what?”, I said.
“Is it there - Los Angeles - is it there?”
“I still don’t know - you disturbed me and made me crash”, which was not strictly true, it was my fault not hers, “I shall need to go back to Oakland and start all over again and it takes nearly four hours in the Cesna - and I can’t go more than ten minutes in the Lear-jet without crashing”.
“Well you do what you like - I’m going back to bed”.
OK - unharmed after my crash - I was determined to find out - so I reset to Oakland - set the time to daylight and started again. Four hours later I found LA - it was there - but not so much detail as San Francisco. And what is more I made a good landing amidst the 747’s at LA International airport.

Soren Kierkegaard, from 'Concluding Unscientific Postscript' -

> Here my soliloquy was interrupted for my cigar was smoked out and a new one had to be lit. So I smoked again, and then suddenly this thought flashed through my mind: "You must do something, but inasmuch as with your limited capacities it will be impossible to make anything easier than it has become, you must, with the same humanitarian enthusiasm as the others, undertake to make something harder." This notion pleased me immensely . . . moved by a genuine interest in those who make everything easy, I conceived it as my task to create difficulties everywhere. ('Concluding Unscientific Postscript', Soren Kierkegaard, trans. D.F.Swenson, Princeton University Press, pp 164 ff)

What are the continuities and discontinuities of VR with other forms of representation?

Wherever we try to put the historical origin, maybe the cave paintings or early carving of figures, it does not matter too much, humankind seems always to have had a fascination with the representational facsimile. We like to construct and experience images which not only symbolise or call up the recollection of objects but actually look like the objects they represent - stand in for them as if they were really present. Certain cultures and religions have resisted the power of the image, Puritan or Islamic for example, but even here this has needed to be an active resistance constantly reinforced against a very strong psychological or cultural driver.

Without falling into the trap of presenting a progressive change as improvement, we can see a broad historical development of the form of facsimile representation. We could characterise the earliest known instances as having an increasing command of the representation of the object. In the main these were the human face, body, animals and other common domestic objects. These representations, whether images on flat surfaces or three dimensional models in wood or stone show a developing facility for the representation of shape, texture, colour and three-dimensionality - the curve of a cheek - the folds of fabric - for example. As is well known, a major development in representation took place progressively during the 14th century. Gradually the rules of visual perspective were codified so that not only was there a facility in the painted representation of objects, there was an increasing command of the way in which these objects were represented as having a rational and consistent relationship to each other in space. Objects in the foreground consistently obscured objects deeper in the represented space and their reduction in relative size was consistent in relationship to their represented depth. Subsequent psychological understanding and relativistic forms of representation from Cezanne to the Cubists and Futurists have brought into question whether the visual (subjective) experience of objects in space conform to their measurable or mathematical, optical physics. However, the conventions of perspective provided an objectification of spatial relationships which counteracted ideological hierarchies, even if they did not displace them, by those of the physical and by implication, scientific, world - the world of measurement and mathematical models.

The idea that this mathematical concept of spatial representation paved the way for a mechanical form of reproduction passing through the simple optics of the camera obscura to the development of photography, however commonplace, is sound. Again though, the security of the technological description of such developments masks the psycho-cultural function of such developments - the fascination with the facsimile - the desire for and pleasure taken in the encounter with an illusion

giving to the senses an experience which can stand in for the real. We might define at least two aspects to this desire and pleasure. One is the passive desire for magic - the pleasure we take in being fooled, and maybe in a more sophisticated way, to savour the interchange between knowing and not knowing the truth behind the illusion. The other we might name as a 'syndrome' Pygmalion, Petrusca or maybe Frankenstein - the desire to create, from our own power, the body which is ultimately alive and real as we are - " a walkin' talkin' livin' doll".

Resuming the historical sweep, defining the means rather than the motives, the attempt to produce ever more adequate illusions of objects and objects in space led, in its mechanical aspect to the attempt to add more and more sensory features to the illusion. The addition of colour, stereoscopy and the most spectacular, the addition of movement through the invention of cinematography and together with this the later addition of sound. Within this cinematic history, the sensory enhancement has included the immersiveness of wide-screen, surround sound and, though short-lived in part because of the clumsiness of the technology, stereoscopy in cinema and even the odd attempt to add touch and smell. All these developments might be seen as evidence of a desire to create a greater and greater similarity between the sensory experience of the representation and experience of the 'real' world.

There is a trap here. By habit we assume the creation of a facsimile representation is a matter of matching sensory experience between the representation and the real world. Also by a deep tradition we assume to test if we are encountering reality or illusion by exploring it with sensory factors beyond those incorporated in the representation - 'I shall believe it when I can touch it' says Thomas. However, the process of adding sensory parameters either to the representation or the test for its reality is not the whole story.

Other features, (and I shall try to define three) not strictly sensory, are entered into the equation of the visual representation. The first of these is narrativity. Thus far my analysis has concentrated on the visual and auditory illusion. With the addition of movement through cinematography, or more precisely, with the development of a visual representation incorporating temporality, it soon became evident that the representation of movement itself was insufficient to satisfy the facsimile desire as it became extended in this new medium. The rate at which the novelty of seeing the illusion of the world in motion wore off is testament to this. The desire rapidly transfers to a wish to see a representation which conforms to our experience of the real world in the sense of behaviour as well as perception. Of course, the representation of human behaviour was not new - it is as ancient as story telling, Greek drama and more recently (in this broad brush history) the novel. What was new in the twentieth century was the fusion of the representation of behaviour with a visual and auditory representation simultaneously predicated on the maximum possible suppression of the distinction between the illusion and the real. An immersive illusion where the encounter with the representation stood in for, and was, in many of its sensory and other aspects, indistinguishable from an encounter with the real. In theatre, the conflict of the hard undeniable presence of actors together with the conventional artifice of scenery and stage required a suspension of disbelief. On the other hand, narrative cinema, with its flow of action, naturalistic acting and photographic realism, increasingly involved not so much a suspension as a suppression of disbelief. The act of collusion by the spectator in cinema - desire for its magic transport - resists recognition of the artifice in favour of immersion in the illusion. This desire not to 'wake' is similar, as Freud made us aware, to the way the dream itself helps us resist waking. That we may draw a parallel between the 'dream-work' and

a ‘film-work’ is tempting except that in the dream it is our unconscious which makes the construction whilst the films construction is made for us. Do we dream it or does it dream us?

The second new condition, instantineity, is of a different order and, unlike narrative (though there is a further complexity to be discussed), it is fundamentally new within our field of representation. Instantineity in representation is a condition made technically possible by remote communication systems, initially telephony, then radio and television. Instantineity evinces an apparent presence manifested through sensory facsimile experienced at a distance from the originating event, but, crucially, experienced at the same moment as the event is taking place. It brings to representation an entirely new feature which is both illusion and reality simultaneously. The illusory factor remains the sense of presence constructed from the sensory facsimile and the reality factor derives from the belief (or knowledge) that the representation is taking place at that same moment as the event in the real world. There is a significant difference if we watch, on TV, Brazil play Italy in the final of the world cup exactly as it is taking place than if we watch it recorded even a few hours after the game. This difference is evident despite having resisted finding out the final score before watching the recording. When we watch it ‘live’ we are sure, or at least believe we are sure because evidence available from other aspects of the context is overwhelming, that not only do we not know how the match will end but that no one else in the world knows this either. They do not know because it is unknowable - the event is continuing in the uncertainty of the present moment. When we watch the recording, we may not know the outcome, but we know it is already known, the event will have happened already. In the ‘live’ broadcast, we are able to share in the continuous uncertainty which is fundamental to the lived moment. In a way this sense of presence remains illusory - we are clearly not present at the game when we watch from our living room - we are still unable to see beyond the frame and sensory parameters which are determined by the camera operator and the limits of the technology, and more crucially we are unable to intervene - we cannot run onto the pitch and take the ball nor incite our fellow spectators to do so. Just as the sensory features of representation are always limited and do not reach a perfect correspondence with the real so the condition of instantaneous presence has its limits. However, in the passive sense, as spectators, we remain able to share that edge of uncertainty as real events unfold. Though of a different kind to the sensory parameters of the representation, this condition of instantineity is an abstractable quality of the representation like its colour or frame and it is equally subject to manipulation or falsification.

Until the technological achievement of instantineity in representation, the image was always retrospective. The picture, whether painted or mechanically produced, recorded a moment in the past and brought it to us in our present. Our passivity not only resided in the act of spectatorship (a fundamental difference between the condition of maker and spectator, story teller and listener) but in the awareness that the image belonged to a moment which had passed. That moment was no longer a matter of uncertainty nor intervention. Of course there was a different kind of uncertainty if that image had a bearing on the present - if it was a document in evidence. This concept of evidence is most dramatic when determining culpability in law but still applies less spectacularly in every holiday snap shot - is this really how we look? - did we really do that? - we were there! For the image in evidence - the image as a document - the question of truth displaces that of illusion in the relationship with reality but the same issues of the limit of sensory parameters apply in both cases. For the image used in evidence, as well as the possibility of falsification - was this image retouched, was the film strip or audio tape edited? - there is also uncertainty based on the limits of the medium -

what is going on in that blur or the point where the grain reaches the edge of its resolution? - whose is that face half cut off by the edge of the frame?

The image used in evidence encounters the instantaneous in two ways. The first by standing in for what was a past instantineity - a moment which had its cruciality - which seems to be made more-or-less reliably available to us because it was made contemporaneously. This is a condition we most associate with mechanical recording, photography, film and sound recording but does also exist in the drawn and painted image and even in the written word. The second way in which the image in evidence encounters instantineity is in its bearing on unfolding events. By carrying forward its documentation from one moment to another it may become a time bomb effecting the unfolding present.

If we review the cinematic (and this is the complexity I suggested) from the perspective of instantineity we see one major aspect of cinema's illusion as the feeling that as we watch its narrative it is taking place in the present and we are present as it is taking place. This predominant present tense mode of cinema can be equally true whether the story is set in an historical or contemporary period or even if it is set in the future. Even within the codes of cinema, the flash back begins instantly to involve us as if the action were present. Again we must be cautious as the word in the form of the story is also capable of evoking a kind of instantineity, an illusion that we are present at the events unfolding. However, it is only through the achievement of an instantineity in representation which is actual - as with Brazil versus Italy - that we can measure the special condition of the illusion of presence as it has emerged in cinema. Perhaps it would be helpful to make a subtle distinction between a condition of illusion where the representation makes the apparent object present for us and a condition where we seem to be brought into the space and time of the event. This later case is where we have become inscribed into the scene, in the first instance by perspective and in the second, into the temporality or action by the narrative. Here the crucial power of its illusion is our sense of presence at and in the event. The adequacy of the sensory illusion, where the object is brought into our presence, when added to the effect of our inscribed presence in the scene through the narrative, is a heady cocktail and is distinct in the cinematic from the written or theatrical story. It is also distinct in its being constructed from building blocks of photomechanical evidence. These are, as we 'know', falsified with lights, contrived actions and actors. They are constructions not records of the unfolding, uncertain world, but we collude in effacing the construction in order to experience the narrative as if it were present for us and we were present with it. This presence, illusion of instantineity is based on our apparent implication in the plot. We seem to care what happens as if it were happening to us. We identify with one or other of the characters - and here, 'identify' means a transfer of our psychological self to that character as if it were ourselves - and curiously we seem able to identify with more than one and shift our identification between them.

Whatever the psycho-social or psycho cultural cause, it is evident that the dominant form for the cinematic, as we find it in the cinema and on television, has become an ultra-naturalistic representation at every level from the mise-en-scene through to the behavioural stereotypes and codes of acting linked to a form of montage and camera placement or movement which heightens the illusion of instantineity. This form reaches a kind of peak in the episodic soap opera where the illusion of instantineity is raised by the continuity of apparent daily development. We are drawn into watching the daily episode as if it were happening on that very day, and like the 'live' football game, were subject to the same uncertainty. The experience we have derived from the truly instantaneous

seems to be transferable as another quality of the illusion even though a retrospective representation. Curiously, the highly extended duration of the narrative over months and years enhances rather than breaks the integration of the events of these illusory lives into our own. Again, at the centre of our collusion seems to be a desire for representations where the distance between the representation and the experience (not just the look) of real life should be as small as possible and may be treated as non-existent. Sociologically this is evident by the way in which soap opera characters, more so than the mediocre stars who play them, become 'real-life' people in the news. Indeed, their emergence as stars with a persona different from their soap opera role might inhibit the extended illusion of instantineity.

So where is the distinction between reality and illusion? If the main test of the distinction is based on sensory factors in deciding the presence or apparent presence of the object then there are a number of serious difficulties. However much we attempt to extend the sensory parameters, frame or 'neutrality' of the mechanics of the representation, these will always be limited by the medium and the represented object will always have sensory extension beyond these limits. In any case our senses are severely limited, they reside within a very narrow portion of the electromagnetic spectrum whether we are using them in an encounter with the real or a representation. In addition to the sensory limits of our encounter with either the real or the representation, both are psycho-culturally coded in interpretation, and psychological evidence suggests this cultural coding extends to perception as well. Furthermore, the medium used for a representation, at the point at which we encounter it, has itself the condition of an object in its own terms. The modernist enterprise in all the arts stressed the reality of the representing object either reducing its illusory elements or countering their representational function. For example Picasso's incorporation of a piece of the 'Journal' onto the surface of the painting acts as an illusionist (pictorial) representation of the newspaper, but simultaneously it acts as the actual object, the piece of newspaper retaining its identity as itself as an actual physical presence and asserts itself as a material form on the surface of the canvas. Instances like these not only exploit the contradictions in coded interpretation but also question whether a binary distinction between illusion and reality can be maintained. Each of these difficulties arise from the way in which a representational facsimile brings to our senses a pattern which is sufficiently close to an encounter with the real object as to be confusable with it - if only for a moment, or - if only with a colluding desire for the eye or ear to be fooled. What potentially breaks this problematic more than any other factor is the dynamic flux of reality and particularly the crucial edge of presence when actual events in which we are implicated are unfolding. We see from the traditions of narrative and particularly the cinematic that this flux itself can be represented in another order of illusion where the behaviour of people and objects become the material of the representation. We also see how the condition of instantineity in presence can also have its place in the representational form. So difficulties in maintaining a valid test of a visual illusion on the basis of its sensory similarity to the object, equally apply as difficulties when transferred to the 'behavioural' similarity between an enactment and the experience of human relationships as they unfold in the real world. The crucial distinction seems to be 'cruciality' itself (thank you Lenny Henry).

It would seem that the only viable basis for retaining a concept of the real is this 'cruciality' of our encounter. We might then define the real as being the arena of irreversible consequence. And for each of us individually, this is the arena in which the actual consequence of our developing life is determined, not always a matter of choice but always a matter of our implication in the dynamic unfolding of events. At its most dramatic it is evident in mortality and loss and in the echo of this in

the impossibility of owning - holding on to - any moment. More positively it is evident in potentiality and transformation and in the exercise of choice, power or creativity. A concept of the real which is based on our encounter in the dynamic world of uncertainty and irreversible consequence promises to displace the dichotomy between the real and the illusory, and certainly between the real and the representational by incorporating the representation as a particular case of encounter with the real. Here the distinction is not one of opposition but of status - what part does the representation play within the real?

But we are jumping ahead, I offered to define three factors which needed to be considered in the relationship between the facsimile representation and the real. The first was narrativity, the second was instantineity and the third is interactivity.

If the early traditions of (pictorial) representation can be characterised by the representation of the object to us - confirming our power over objects - and if the more recent state of our representational (cinematic) technologies have placed us as spectators within the representation of unfolding events, then interactivity seems to offer a representation of our intervention in those events. Where the cinematic implicates us as spectators through the processes of identification, supported on a layer of photographic, sensory simulation, and an illusion of instantaneous presence, interactivity promises us implication as protagonists. I and others have rehearsed many of the arguments surrounding the narrativity of interactive forms - the changed position and role of authorship, the branching or parallel narrative against fundamental synthesis of imaginary worlds and the changed condition of identification as the spectator becomes protagonist. Here the subject is Virtual Reality and, in my argument, its continuity with a psycho-cultural enterprise from pictorial representation using perspective to the dynamic 'narrative' of represented events. Though VR can be differently defined, and another history proposed, its most prominent device is the incorporation of a Euclidean concept of space, interpreted through vanishing point perspective where the viewpoint is capable of movement rather than having a fixed station. In addition, the virtual space is capable of interrogation through the interactive intervention of the ' spectator' or protagonist. My aim is not to predict the future path for VR nor interactivity within this broad field. Some of that future is already with us from: simulation - my flight to LA; computer adventures, violent or sophisticated; computer art by Geoffrey Shaw and many others; attempts at interactive cinema with the audience pressing buttons; or interactive digital TV where the viewer may select viewpoints in sports coverage. My aim is to try to understand certain of the fundamental issues as this new capability within media becomes language and convention more-or-less continuously with the social or cultural functions of existing media and particularly where it seeks to develop as art.

If we return to my attempted definition of the real as the arena of irreversible consequence, one overwhelming feature is that we become implicated in the consequence by our actions and choices. Our identities in this way become the trace of our imprint in the world as it moves from potentiality through the uncertainty of the present into history. Our history of choices in their turn determine our new location in the present. We should not forget though that this exercise of choice and effectiveness of action is always limited by our social environment - those things beyond our control. And in certain tragic circumstances - the poor Kosovan seeing family, tortured, killed, home destroyed - choice and effectiveness may be virtually (that word) non-existent. Interactivity, as we understand it in the digital in general and particularly in the constructions of VR seems to model the relationship between choice and action and its effect on the development of a facsimile

representation. Though this capacity changes, and maybe radically changes certain conditions in art and media, it does not fundamentally alter the issue of our relationship to illusion, representation and reality. That we previously entered a fiction in cinema by passive identification with one or other of the characters and may now enter the action as a protagonist does not radically alter the role the fiction plays for us nor our motivation to engage in it. This is particularly the case as the structure of choices and their relationship to outcomes must be just as predetermined by the work - through the (computer) programme - as is the linear outcome of a classic film. In the interactive VR the outcomes may be multiple or we may fail in our objectives, quest, and not satisfy our desire. However, these changed (extended) parameters of the representation only continue the process of illusion by incorporating another set of features we find in the real world. As such the form of the engagement does not extend beyond the programmed parameters of the work.

I have attempted to describe a developing historical process in the field of facsimile representation - a broad sweep: object representation enhanced by the addition of increased sensory parameters; the command of coherent spatial representation added through perspective; subsequent mechanisation through photography; the addition of motion and temporality through cinematography; the fusion with sound recording; and with the conventions of narrative. All this producing an art where the adequacy of the representation - its power as facsimile - is extended to the representation of behaviour and action providing an immersive sensory experience sufficient to stand in for, stand instead of, an experience of the real world. It provides for us an experience where, whilst engaged in it we must suppress the contradiction between the representation, the represented and the material reality of the artifice. I have also added into this sweep the effect of actual instantineity, the capacity for live broadcast, its prefiguring device in the illusion of present (tense) in the experience of cinema narrative and its subsequent influence on the extended, episodic naturalistic soap which has such a dominant place in contemporary culture.

The most recent phase in the expression of the Pygmalion syndrome, VR, provides an interactive immersive environment which simulates not only the look, potentially the feel and other sensory parameters, but also incorporates, through interactivity, an extended illusion of presence. 'Objects' are present for us and we are apparently present for them. This is confirmed by our ability to traverse the space at will and further confirmed by our ability to interact with the objects and change the outcome of depicted (narrative) events. But the contradiction remains, however convincing the illusion - and the illusion of behaviour is more fundamental than any visual illusion of objects - the incorporation of our effectiveness into the representation is not the same as our action in the arena of real consequence. The modernist enterprise in art, as with Kierkegaard's determination to 'create difficulties everywhere', drew attention to this contradiction largely by the juxtaposition of illusion and the affirmation of the presence of the work as 'object'. Except for the experimental film which remains a separate form, this modernist enterprise has had no influence on the developing conventions of cinema nor its incorporation into the conventions of television. Representation there remains without contradiction and devoted to illusionist immersion. VR, in its popular manifestation, appears to seek a continuity with the traditions set by the cinematic - sensorily convincing facsimilie and engaging narrative - but with the added illusion of effective involvement in the action. However, VR as the basis of an art form continues to need a way in which the contradictions between engagement in the arena of irreversible consequence and incorporation of interactivity as a parameter within a representation can be integral to the experience of the work.

If, as I maintained, the only viable definition of the real is engagement in the arena of irreversible consequence and that the distinction between reality and illusion is not one of opposition but of status, then the incorporation of contradictions in the VR art work is a neccesary aspect of providing our ‘cultural language’ for evaluating this status.

‘The English Earbook’ and Creative Linguistics

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The English Earbook is a proposed atlas of our soundworld and the words we use to map it. Based on my work as a lexicographer and information mainly from electronic reference sources, most notably the Collins Bank of English, the project aims to chart the territory occupied in English by the language of sound and hearing. This is a work in progress, and any presentation given will consist of my findings to date and some of the issues these raise with regard to the perceived relationship between language, consciousness, culture and technology.

1 Introduction

My career as a lexicographer began in 1984 with work on the first Collins Cobuild English Language Dictionary. This publication was a new venture based on the evidence provided by corpus linguistics research. Developments in computer technology had recently allowed language research to be conducted using large bodies of text as raw material from which individual words or terms could be extracted and examined to determine meaning, structure and usage. It was this use of new technology and its implications that underpinned the Cobuild dictionary, intended as a descriptive overview of English, based on a body of evidence rather than on any prescriptive principles of how the language ought to be used.

2 The Bank of English

In 1984 the Cobuild corpus, established by Collins as a research project at the University of Birmingham, contained approximately 6m words of text. It now contains approximately 400m words and includes books, newspapers, magazines, leaflets, transcriptions of radio broadcasts and transcriptions of conversations.

Using search and sorting software, a specified word or phrase can be found and its frequency and the frequency of its co-occurrence with other words or phrases (collocation) investigated.

Since 1984 I have used the Bank of English in my work for Collins on a range of bilingual and monolingual dictionary projects. However it has always seemed to me that it is a much-underused resource. Although the demands of publishing keep the lexicographer’s mind focused on the project in hand almost to the exclusion of all else, there are other ways of using this resource that exemplify the tension implied in the phrase ‘technological push vs creative pull’.

3 Technological Push vs Creative Pull

3.1 Collins-Robert

For example, I was commissioned to research and write a series of short pieces describing aspects of British and American culture for inclusion in the Collins Robert, the company’s principle French/English Dictionary. Instead of looking up words in order to monitor their meaning and usage for linguistic purposes, it occurred to me that I could use the corpus’ linguistic search engine as the index of a large electronic encyclopedia of contemporary culture. So, terms such as ‘Guardian reader’, ‘Sun reader’ or ‘green welly brigade’ could be accessed and their connotations, the assumptions built into their usage in popular culture, could be noted in precisely the way that would be most helpful for non-native speakers.

3.2 Word of the Week

I was subsequently commissioned to write a series of ‘Word of the Week’ features on particular words for an online education service, and used the search engine in the same way to look for productive use of particular terms. For example I produced a piece about idioms derived from Lewis Carroll’s ‘Alice’ books and was able to cite individual examples of creative usage as well as commenting on overall patterns. On another occasion I looked up terms derived from George Orwell’s ‘Nineteen Eighty Four’ – this was before the two TV programmes (‘Big Brother’ and ‘Room 101’) that the book also gave name to.

3.3 New Words

Another use of the corpus I am involved in is the monitoring of new words and new senses of existing words, evidence of which can be found using simple but powerful search tools. Although the words themselves are common property, the work done investigating them is part of the periodic updates carried out on all publications so I am unable to give more details.

3.4 Paper World Room

More recently I exhibited 'Paper World Room', an installation using raw printout from the Bank of English. I photocopied this onto sheets of A3 paper and used them to paper the walls, ceiling and floor of a room at Glasgow School of Art during the CADE (Computers in Art, Design and Education) conference held in April. Examples of usage of the word 'wall' were used to cover the walls, 'sky', ceiling', 'top' and 'up' covered the ceiling and 'ground' 'floor', 'bottom' and 'down' covered the floor. In addition I put a single column of photocopies of 'north', 'south', 'east' and 'west' at the points of the compass. I also highlighted these words on the sheets using coloured highlighter pens.

4 The English Earbook

For the English Earbook I propose to examine the language used to refer to sound and hearing, approaching the subject from a number of different perspectives and using mainly electronic technology. These perspectives include

- the nature and use of onomatopoeic or imitative words, studied synchronically to examine patterns of contemporary usage, and diachronically to look at changes in lexis over time
- the basic terms and categories available specifically for describing and classifying all sound events
- ways of describing and classifying extended, detailed or unusual sound events, and the lexical gaps through which experience challenges language
- the language of sound and hearing used figuratively to refer to other areas of experience.
- conventions of spoken and written communication
- acoustic features of spoken communication, including aspects of paralinguistics and sociolinguistics
- words regarded as having special sonic qualities, for example spells and mantras.

In the absence of any funding, this project will of necessity proceed at a pace dictated by the pressures of paid work and other commitments, and is a work in progress rather than a completed artefact. It will however allow new connections to be made between existing resources. One of the ultimate objectives, at this stage no more than an idea, is a web-based resource comparing the material investigated in the English Earbook with those available to the users of other languages.

Video Based Gesture Recognition by Artificial Neural Networks for Interactive Music Systems

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1. Abstract

In recent years a vivid disscussion about processing of gestural data in musical applications came up. The discussion emerged from the background of interactive computer music systems and their use in performances, but also from the experiences of novell interfaces to control the generation of sound and musical processes. Due to the availability of a larger range of sensor systems and the increasing processing power, as well as novell software developments various combinations and paradigms of processing gestural data were established. They all use gestural data to control parameters of the composition or the artistic environment such as sound, light etc.
Related to the discussion abaout processing of gestural data is the question of Mapping of control data onto musical parameters. Issues like the detection of higher level expressive information of music parameters are from great interest.
For different applicatiions and goals a range of sensors and processing algorithms are available, each with specific advantages and drawbacks. Especially in dance or installation environments video systems are often used to track movements or objects of interest.
In our paper we describe a videobased system we developed for the recognition of gestural data. It analyses bodymovements to extract high level information of the movements which then can be used as artisitic material such as control of sound, musical processes, light etc.

2. Video Based Data Acquisition

The use of a videobased system offers the advantage of common available input devices. The setup process is feasable and the achieved data are directly comparable to the visual impression a human beeing would get through its eyes.
The drawbacks are the high data rate and processing complexity evolving from the two-dimensionality of the acquired data. The comlex and sophisticated processing of visual data through the human eye additionally increases the aspiration to video systems.
Several video systems are available targeting the analysis of video data for tracking or detection of movement. They are based on colour detection or the change of successive video frames and are used in a wide range of musical and artistic applications.
We believe that gestural processing is strongly related to the amount of movement of the gesture. For that in our approach we choose the rate of change of luminance points of consecutive video frames as the main feature for the recognition process.

3. System Overview

The raw video stream from a common available camera is analysed and relevant information is extracted and presented to the neural network. The gesture recognition is achieved through a Time Delay Neural Network architecture.
The output of the neural network is evaluated using a post process function to produce a decision wether a trained gesture was presented or not. On a medium sized workstation (O2, 180 Mhz) we achieved realtime recognition at recogniton rates of about 85% for three gesture types.

4. Trained Gestures

As an initial experiment we used video data from three different hand gestures with which we trained the neural network. The trainings set for one gesture type was 3 gesture samples with different speeds. The data extracted from the stream with the below described preprocesing procedure is similar to relevant gestures in dance or installation situations.

5. Preprocessing and Feature Extraction, Luminance Rate

Since we believe that gestures are strongly related to movements we initially used the rate of change of luminance of consecutive frames as the relevant feature to be presented to the neural network.
For that we extract the luminance of consecutive frames from the rgb data of the video stream at relevant pixel positions and compute the rates of them.
To reduce the amount of data to be processed, but maintain relevant gestural information we use a combination of pixel resolutions.
A clustering process is used to detect the overall location of the gesture, to achieve position independency and increase the resolution of the relevant video data.
The position of the gesture is then used to define a subframe consisting the relevant gesture at an higher resolution which is finally fed into the neural network.

6. Architecture of the Artificial Neural Network: TDNN

For the recognition of the gestures we choose a Time Delay Neural Network architecure.
This neural network type was developed for the use in phonem recognition but several works applied them succesfully in gestural processing as well as in musical audio applications.
This neural network architecture provides recognition of timed patterns at low processing power requirements independent from the pattern speed
TDNNs were designed for processing data in 3 dimensions like a spectrogramm (frequency, magnitude, time). Due to the two space parameters of video data (x, y) an additional pattern dimension has to be integrated into the network architecture which gives an overall number of four parameter dimensions (x, y, level, time). As an initial attempt we split the video data into appropriate parts and presented them to the normal 3-dimensional network architecture. Although this procedure offered good recognition rates at low cpu costs, we will discuss the need of an optimised architecture concerning the 2 dimensional space information of video data emphasizing the effects of neigbouring neurons.

7. Post Processing

The output of the neural network is processed with threshold and filter functions. Together with the overall level of the luminance rate the onset and offset of a gesture as well as the type of the gesture is estimated.
The output of the recognition process is displayed on the screen as well as sent to external devices via midi as note on and offs.

8. Hardware Setup

The realtime recognition process was done on the same hardware environment as the data acquisition.We used a Silicon Graphics O2 with 180 Mhz and a resolution of 480*320 pixels.
A standard consumer video camera as well as a low cost webcam were succesfully used.
With the applied feature extraction, segmentation and clustering procedures we were able to achieve neural network based gesture recognition in realtime with the described recognition rates.

9. Recognition Rates

Various parameters of the experiment, like distance, location, rotation and size of the gestural object (here: the hand) in the video frame have influence on the recognition results. Overall light conditions, gesture speed etc, are additional parameters.
We roughly estimated the recognition rates by presenting the neural network 10 samples of each trained gesture. The 10 test samples for one gesture type were similar in location and rotation, but different in gestural speed, and lighting conditions. The estimated recognition rates were about 85%.

10. Integration into a Performance Environment

The results of the recognition process as well as values of the extracted features can be sent to external devices through a standard midi interface. In a test setup we succesfully played three different audio samples through midi on a standard sample device. Additional parameters, like the overall rate of change of consecutive frames can be sent via midi as subgestural control information.
We will discuss the integration of the system into common computer music environments like jmax or max, which gives a wide flexibility for the use in musical situations.

11. Conclusion

Our aim was to investigate the use of a lowcost setup to achieve a gesture recognition tool which can be used in a wide range of interactive, artistic applications such as dance, installations, novell interfaces and more.
For that we developed a videobased system based on a a Time Delay Neural Network architecture. We use luminance rates of consecutive frames as the main pattern feature providing a large independency on different lighting conditions, especially varying light temperature and light intensity. It also reduces the amount of data to be processed significantly.
The used segmentation and clustering mechanisms resulted both in position

independency of the gesture in the video frame and reduction of data to be processed by the neural network.
Considering the small size of the used trainings-set the achieved recognition rates of 85% are promising for the choosen Time Delay Neural Network architecture.
Further work will provide details about the achievable size of gesture sets and the use of different gesture types, like hand gestures or dance gestures. We will discuss the influence of the size of the gesture and the rotation as well as clustering techniques for detecting multiple gestures in a video frame.
With the proposed system we developed a promising environment for detecting a wide range of gestures in different surroundings like interactive compositions, performances, dance and installations.

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Towards an Integrated Handwritten Music Manuscript Analysis and Recognition System

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Introduction

This paper presents an ongoing research project on handwritten music manuscript analysis and describes a framework design for an integrated system which brings together a convenient music input interface using optical scanning technology and a graphical-user-interface for facilitating editing of the OMR (Optical Music Recognition) output that takes account of musical syntax, conventions and patterns.

A brief background of OMR is presented, together with a discussion of some of the main obstacles in this domain. General low-level pre-processing modules for both printed and handwritten manuscripts are described, with illustrations, followed by a discussion of the development of a stroke-based segmentation approach using mathematical morphology.

High-level domain knowledge enhancements and a semi-intelligent user-interface are proposed, and output format and future directions are outlined.

Optical Music Recognition

A robust OMR system provides an efficient and convenient approach for musical data acquisition, transforming paper-based music scores into a machine representation. Once the data is represented in a machine-readable format, it can be used by a wide range of computer-music software, for example, for musical analysis, printing, playback, transposition and many other useful processes, in the same way as Optical Character Recognition (OMR) is useful for text processing applications.

Currently, the most common way of entering musical data is by means of a MIDI keyboard. This requires manual performance (or mouse-keyboard interaction), which is time-consuming and requires some experience in the use of specific software. Furthermore, there are many symbolic and graphical objects that are used to represent the intended/editor edited music (on paper), which are difficult to convey and capture in the information translation between a performance (played on a MIDI keyboard, or other instruments, using a pitch tracking approach [Cooper and Ng 1996]) and a score-based notation. Examples of such symbols are slurs or phrasing markings and expressive symbols (e.g. staccato and accent).

OMR was first attempted over thirty years ago [Pruslin 1966] and there are currently a number of commercially available packages for printed music score recognition [Midiscan, Scorscan, SharpEye, PhotoScore]. OMR for printed music scores has been particularly active over the last decade [Anquetil *et al.* 1999, Bainbridge and Carter 1997, Bainbridge and Wijaya 1999, Fujinaga *et al.* 1998, Itagaki *et al.* 1990, Ruttenberg 1991, Ng 1995, Sayeed Choudhury *et al.* 2001, Stückelberg *et al.* 1997] and OMR for handwritten manuscripts is in an early stage of development [Roach and Tatem 1988, Ng *et al.* 1999, Ng 2001]. Reviews and background on the development of various OMR systems can be found in Blostein and Baird [1992], Selfridge-Field [1994], and Bainbridge and Bell [2001].

Obstacles

Musical symbols are highly interconnected. Besides interconnection between symbols, the grid system (the staff, a group of stave lines) on which music symbols are written presents another layer of complexity. Most current approaches detect and remove the stave lines during pre-processing in order to reveal the musical objects.

Musical symbols may connect horizontally (for example beams), vertically (for example chords) or be overlaid (for example, slurs cutting through stems or bar lines). Furthermore, when symbols are grouped (beamed), they may vary in shape and size; for example, consider the shape of isolated semi-quavers and the many possible appearances of four-semiquaver groups. All the interconnections and variations can occur simultaneously, resulting in difficulty in the modelling of the symbols for detection and recognition.

Handwritten manuscripts impose a further layer of uncertainty, because of the inconsistency in writing styles, their typically slanted or curved line segments, fussy and uneven fillings (e.g. solid or hollow note-head) and many others anomalies. The qualities of the input dictate the output, however, and it is difficult to give a quantitative measure of the input qualities, which varies from almost unreadable (requiring high-level domain knowledge to interpret the writing), to very consistently written manuscripts (which appear almost like printed font). Besides inherent complexity in the notation, handwritten manuscripts also involve corrections (e.g. cancellation marks) and other unexpected markings; for example, additional note sequence or bars in the margin (outside the staff span).

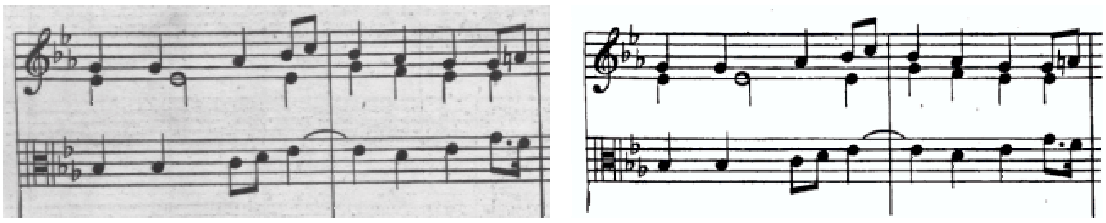
Main Processes

Figure 1 presents the main process flow for an earlier prototype designed for printed music scores. The prototype captures grey level bitmaps from an optical scanner or loads an image file directly, as input. Generally, the input bitmap is 300dpi in 256 grey-level or binary. However, in practice, the system is capable of analysing images captured with 200dpi (depend on the original input size and density) and higher resolutions since the processing and recognition processes are normalised by a grid system. If the input image is not binary, as detected by the software, the first process is to automatically determine and separate the foreground (writing) pixels from the background (paper), using an iterative thresholding approach [Ridler and Calvard 1978, Lloyd 1985, Venkateswarlu and Boyle 1996] and the image is binarised. In practice, it is difficult to position the music score with the staves perfectly horizontal,

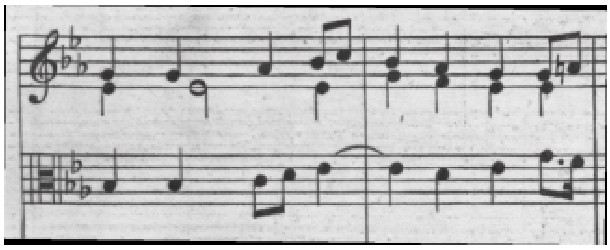
during digitisation. To simplify further processing, the skew of the input image is automatically detected and corrected by rotation, and binarisation is reapplied to the corrected image (see Figure 1(b)).

Stave Line

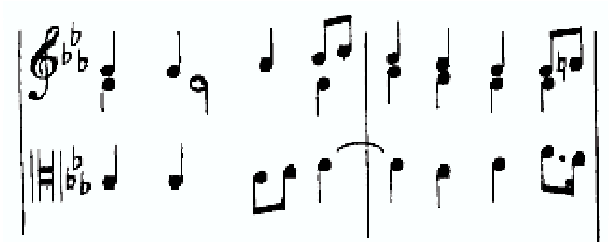
The stave line is the fundamental element of the CMN. It forms a grid system for musical symbols, of which most are related to the geometry of the staves. Using the binarised image, stave lines are detected and electively removed [Ng 1995] in order to separate the musical symbols, which were interconnected by the staves. The detected stave line thickness and the space between stave lines are used to provide the fundamental unit for normalisation, because the stave lines form the grid system which constrains the relative sizes of musical symbols.



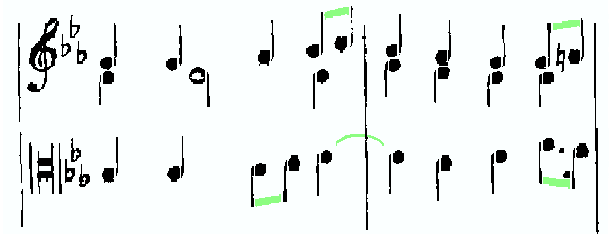
(a) Input (left), and (b) binarisation (right)



(c) deskewing



(d) Binarisation and stave-line removal



(e) Sub-segmentation

Figure 1: Pre-processing and sub-segmentation

Sub-segmentation and Recognition

The prototype uses a divide and conquer approach, sub-segmenting complex and composite groups of music features into low-level graphical primitives, such as vertical and horizontal bars, ellipse (note-head), dot and others (see Figure 1(e)), before recognition.

Recognition of other primitives is performed by interplay between the classification and the sub-segmentation modules. The classification module relies on the sub-segmentation module to extract the primitive features for recognition, and the sub-segmentation module relies on the classification module to satisfy one of its termination criteria. The classification module uses simple features such as the normalised width and height of the feature's bounding box, and performs the recognition based on a pre-sampled training set, using a k-Nearest-Neighbour (kNN) classifier [Ng and Boyle 1996].

Reconstruction

After primitive classification, the music objects and final results are reconstructed using basic musical syntax and conventions. This approach has proved satisfactory for printed scores and has provided a useful intermediate stage where many neighbouring primitive classifications can be checked and confirmed with each other. However, its sub-segmentation process relies on the straight edges of the symbols and it is generally not as robust when dealing with handwritten manuscripts because of their typically slanted or curved line segments [Ng 1995].

Handwritten Manuscript

In order to trace the typically slanted handwritten stroke, a mathematical morphology approach commonly used in document imaging [Suen and Wang 1994, Ablameyko and Pridmore 2000] is adapted to skeletonise the musical symbols. The process of skeletonisation reveals junction- and termination-points that assist sub-segmentation.

Junction points are pixels on the skeleton with more than two connected foreground pixels and termination points are skeleton pixels that have only one (i.e. the beginning or end of a line segment) or zero (i.e. a dot) connected foreground pixel.

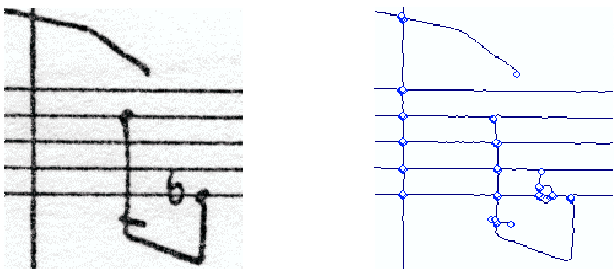


Figure 2: Undetected smooth joints between the two stems and the beam. Input (left). Thinned output (right): detected junction- and termination-points are indicated by circles.

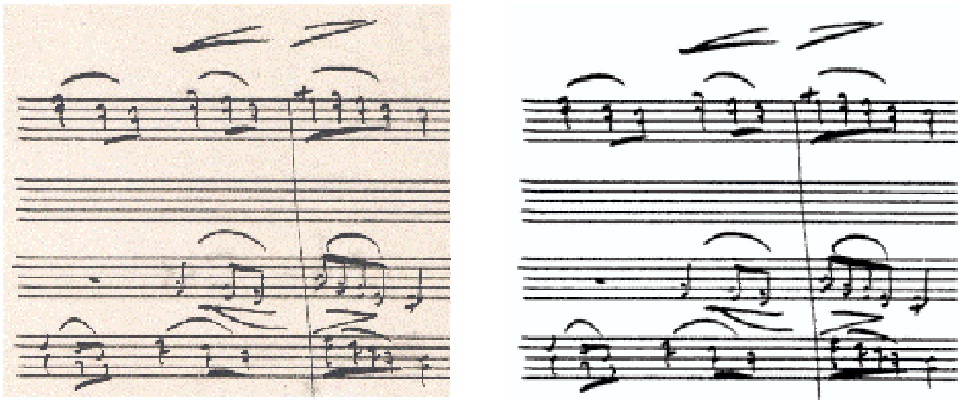
These points, however, are insufficient to locate all the connections between graphical primitives (see Figure 2) and further techniques involving edge detection and stroke direction are required to enhance the sub-segmentation process. From the detected junction- and termination- points, a stroke-tracing algorithm is applied to extract stroke-like line/curve segments. These segments are then divided into horizontal line, vertical line, and curve.

Using this sub-segmentation approach, sub-segmented primitives can be classified using the same classifier module, with an appropriate training dataset, and additional feature vectors to make use of information extracted during the skeletonisation process and the junction point distribution.

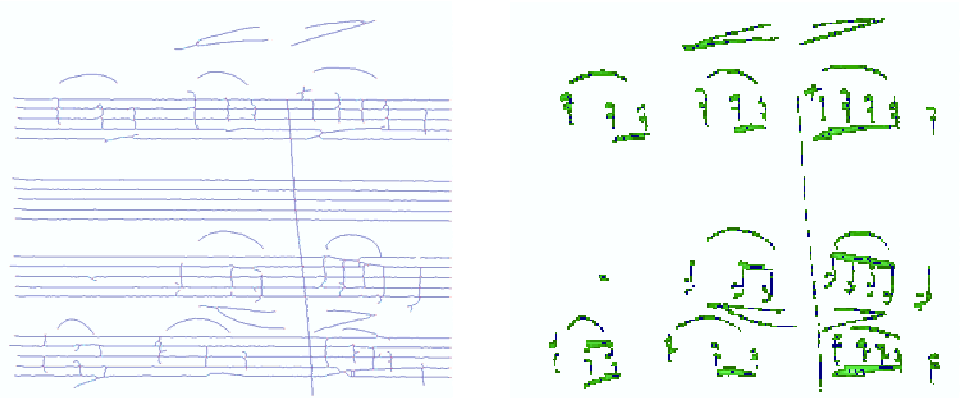
An online experiment to capture and model the writing process of musical notation; stroke directions and sequences, using a graphic tablet is currently under development. The handwriting process is captured as a sequence of equal-time-interval-samples in (x, y) 2D coordinates of pen-tip movement $\{X_t, Y_t\}$. Model based enhancements for the stroke-based segmentation and reconstruction modules, represents the work in hand.

A dataset of handwritten samples was collected for analysis and training of the classifier. From the experiments, it was found that a writing model (the stroke sequences and directions) could enhance stroke tracing, and further research of handwriting stroke modelling is currently under development. Initial experiments used a setup with a video camera and colour sensitive software to detect and track the motion of the pen nib. In order for the video camera to have an unoccluded view of the pen nib at all times, the camera had to be placed below a transparent writing surface, and this was not felt to provide natural or comfortable ergonomics for many experimental subjects. Equally, the resolution, and thus the effective sampling rate, of the set-up was limited to 25 frames per second which was insufficient for accurate velocity, and potentially could result in aliasing errors. Hence a tablet interface is currently under evaluation. Because of the tablet's higher sampling rate, it offers much higher resolution for stroke tracing, and additionally, it provides additional data such as pressure. It is hoped that a combined approach using camera and tablet will offer accurate data acquisition and at the same time provide a visual record of posture, and the orientation of the hand.

Pre-processing and reconstruction modules are independent of the musical features and can apply in both printed and handwritten scores. Figure 3 illustrates processing of a sample of handwritten manuscript.



(a) Input (left), and binarisation (right)



(b) Skeletonisation (left), and stave line removal (right)

Figure 3: Handwritten manuscript.

User Interface

Many factors in the input source, for example resolution, contrast, and other inherent complexities, could influence the performance of the automatic recognition and transcription process. In order to provide flexible and efficient transcriptions, a graphical user-interface front-end editor with built-in basic musical syntax and contextual knowledge to assist the transcription and output, is being designed.

This editor will not only form the front-end to the recogniser, but could also serve as a general-purpose notation editor. It is closely integrated with the recognition module. Unresolved features and recognition below an uncertainty measure will be output with a list of the top N possible classifications, so that the user can select the correct item. This could in turn provide feedback to the classifier to enhance the training data-set.

Using the data collected for the writing model described earlier, simple mouse (or pen-base) input gesture (stroke) can be tracked and the intended musical symbols can be entered without the need for symbol selection which usually involves user interactions with a menu or a palette.

Patterns in the data, both melodic and rhythmic, can also be analysed [Cambouropoulos *et al.* 1999, Cambouropoulos 2001, Tee *et al.* 2001] and tracked.

Repetition (with or without transformation) in the pattern could also be detected and the features used for result confirmation and for input prediction. For example, during manual data entry, if the note-sequence is found to be similar to part of another existing sequence, the predicted sequence could be overlaid (with a different colour) to speed-up data entry, just like the auto-complete feature available on major Web browsers for URL entry.

High-Level Enhancements

The interface is also designed to contain an extensible set of analysis modules, including automatic tonality and time-signature detection, and correction functions using the detected high-level interpretation or user-provided global information.

The results of this process provide important evidence for the internal organisation of notes and rests within bars of the music being parsed. It is possible to detect errors in terms of missing or mis-classified symbol types and intelligently replace them. With a known time signature, the total duration of a bar is established, and any discrepancy between the estimated duration and the expected duration indicates missing or misread events. This paper [Ng and Cooper 2000] discusses the conventions of grouping (beaming) and its application to allow us to work at the sub-bar level and provide evidence of missing or misread duration information.

Details of the rule-based approach for the automated tonality detection can be found in Ng *et al.* [1996].

File Format

Currently, the default output format is ExpressiveMIDI (*exp*MIDI) [Cooper, Ng and Boyle 1997], which is compatible with the standard MIDI file format, and is capable of storing expressive symbols such as accents, phrase markings and others, with detail localisation parameters, in order to preserve the layout of the original input manuscript.

There have been a number of developments on musical file formats, for example Notation Information File Format (NIFF), Standard Music Description Language (SMDL), MusicXML and others. It is intended to include input and output filters for these and other commonly used musical file format such as GUIDO and Score.

Conclusion

In this paper, a brief background of OMR and its main obstacles are presented, with discussion of an integrated OMR system which brings together a convenient music input interface using optical scanning technology and a graphical-user-interface for semi-intelligent editing of the OMR output using spin-off development of gesture-based input method.

With the advancement of digital imaging technology, input using off-the-shelf digital camera with fast image acquisition time is an attractive alternative.

As well as direct applications, such as playback, re-printing, analysis and digital archiving, a robust OMR system would enable efficient translations, for example, to Braille notations. We are also interested in extending the recognition system to process other musical notations beyond the Western Common Music Notation.

Acknowledgement

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QSketcher:
An Environment for Composing Music for Film

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Abstract

We describe QSketcher, a new environment for composing music for film. The main design focus is the support of the early stages of the creative workflow, from idea conception through realization, rather than the mere order and synchronization of musical fragments with film. This paper describes the design process and rationale, the system, the user environment, and how they relate to one another. Novel aspects of the system include a free-form 'idea space', a main workspace that can be configured to individual needs, an "idea capturing" facility, a workflow tracking mechanism through which previous workspace states can be examined and restored, and the ability to create a variety of relationships among musical elements.

Keywords: creativity, composition, user interface, interactive, music representation

1. Introduction

The music composition process has evolved over millennia as a balance of opposites: inspiration versus perspiration, broad formal approaches versus minute detailed work, macro-level (or structural) conceptualization versus micro-level (e.g., note-level) editing, and so on. When composing in the traditional ways, one moves frequently from mode to mode: an idea pops up, one captures it, and then thinks critically about and develops it. Another idea pops up, and the process iterates. One can easily shift focus to thinking about the entire composition and how a small motif relates to the whole, for example.

Unfortunately, the technological tools available for composing music do not readily support this kind of creative workflow – they are geared towards realization of preconceived ideas. Thus, the user interface found in many commercial applications models recording studio machinery, namely the multi-track recorder and mixer. This model has little to do with the traditional process of creating music. So, although the multi-track recorder metaphor is appropriate for the mixing and audio post-production stages, it provides little leverage in capturing and developing musical *ideas*, which lie at the heart of the early stages of the creative process.

In addition, the environments for composing music that have evolved over five decades in academic and commercial settings still fall short in their ability to manipulate music directly in terms of musical concepts. Computer languages for composing music, for example, typically model limited structural aspects of music through a score, e.g. instrument, part and score, and provide a suite of algorithms to manipulate that score. The score is often expressed in physical terms, such as frequency and amplitude, and the tools provided for its manipulation are often borrowed from computer science with few changes. This detachment from the intuitive musical concepts in which composers think, and from the musical experience itself, places an unnecessary cognitive burden on the composer. Computers are supposed to make work easier, not harder!

Our goal was to develop a tool that overcomes these limitations. To focus our efforts, we addressed a specific musical task: that of scoring film. We felt that this would not overly restrict the musical style, that general issues relating to supporting computer-assisted composition would still need to be addressed, and that the film environment in particular provides structure that resonates with many of our ideas. We formed a cross-disciplinary research team consisting of computer music researchers, system developers, and composers (note that all team members have strong musical backgrounds; most have strong technical backgrounds). Together, we examined the creative workflow, critiqued existing solutions, and focused on areas that we felt needed attention. We also employed a highly iterative development strategy with our composers involved in most stages. Our focus on the creative workflow and musical concepts had a profound impact on the system design, from the underlying data structures used for music representation to the overall user environment.

The result is *QSketcher*, an environment designed to allow composers to move fluidly between dichotomous

modes (inspiration/perspiration, capture/manipulate, and macro/micro editing levels), while directly supporting a variety of common compositional concepts, so that composers can work using the terms in which they think.

Interestingly, these dichotomous modes are also present in a wide variety of creative tasks – writing, drawing, preparing presentations, as well as more technically-oriented activities such as software design and development, architecture, and even the act of research itself. The concepts uncovered during the QSketcher project are important in these domains, and many of the solutions implemented would prove quite useful there. Several of the authors are currently adapting these techniques to other areas. In fact, we believe that the "tip of the iceberg" of an important research area in HCI is emerging: developing information technology tools to support creative work.

The remainder of this paper describes creative workflow as we understand it, the demands that supporting creative workflow places on a system, and the specific aspects of QSketcher developed to address these demands. We will draw parallels to other domains where appropriate, and conclude with remarks on future directions for this research.

2. Creative Workflow: Capture, Organize, Manipulate

Throughout our dialogue, three general areas emerged in which composers felt the need for better tool support: the ability to quickly *capture* musical ideas, *organize* those ideas in a useful manner, and *manipulate* them in musically meaningful ways.

It was clear that the composer's workflow would be much more fluid if the system made it trivially easy to input their ideas - as graphical sketches or scribbles, textual annotations, music played on a keyboard, and so on. Any break in the flow — to enter record mode or handle other technicalities of operating the system — could disrupt their creativity, and an idea might be lost. Ideally, every idea should be captured, and capturing should be allowed at any stage in the creative process. To support this, we incorporated features such as the "Infinite TakeVault" and an integrated freehand drawing tool, both described later.

With every musical idea captured, the system must also prevent information overload. This can be accomplished by providing intuitive and powerful mechanisms for organizing ideas, relating ideas to the relevant music or film content, and searching for ideas. QSketcher supports these goals with features such as an integrated content palette (a database allowing for searching materials by many criteria), and the ability to organize ideas alongside musical materials using the visual layout of windows.

Finally, the system should provide musically meaningful ways to manipulate content, thereby allowing the user to rapidly explore the musical space, experiment with ideas, and develop and structure musical fragments into a final work. To this end, QSketcher supports high-level structural manipulations as well as precise low-level editing.

As we proceeded with the design, we uncovered four pervasive higher-level issues that have great impact on the system's effectiveness in each of the above areas: *conceptual orientation*, *context*, *state,* and *relationships*.

Conceptual orientation refers to the system's use of musically meaningful concepts in its visualizations and controls. Composers think about music using musical concepts such as motif and development, crescendo, transformation, or tension and relaxation. As an example, QSketcher allows the composer to structure his composition in an arbitrary manner – as a hierarchy consisting of notes, phrases, sections, and cues, as an arrangement of tracks, or any combination thereof – and then to manipulate the composition using that structure. Another example is QSketcher's ability to adjust tempi by directly manipulating an object representing the length of a structural element, in relation to film events in the global timeline.

Context relates to the composer's mental state while working on a particular problem. For example, composers often cover their desk or walls with sketches of musical ideas, outlines of musical sections, fragments of music and motifs, photographs of objects relating to their work, notes about intent, scripts, cue lists, todo notes, napkin scribbles and the like. These objects help the composer mentally work out various relationships and musical processes that are an important part of musical creativity. In previous systems, the computer and monitor hold only a small portion of the working environment. We believe it is crucial to capture much more of the working environment "inside the computer." Then the computer can do far more: track relationships between materials and tasks; capture ideas along with the rich context in which they were created; support a much smoother flow between different tasks; and quickly recreate different versions of the environment according to the needs at hand.

While we do not expect to model the cognitive facets of these relationships directly, we recognize that the visual layout of objects in the composer's workspace often reflects important aspects of his thought process. We therefore developed a user interface that allows him to place *anything anywhere*, creating what we term a *visual layout*. To assist in recovering the mental context as it relates to a given problem, layouts are remembered and easily recalled within QSketcher. These ideas were central to the design of the "*Idea Space"* (see figure 2), described in a later section.

While *context* loosely relates to a set of things that the composer associates in his mind with a given problem, *state* is connected with both the entire composition and the musical experience at a given point in the work. When working on a given section, it is important for the composer to correctly assess what the musical experience (state) will be. Listening to the work from the beginning to that point in time is time consuming, and often disrupts the workflow. Moreover, the preceding sections may be incomplete.

Our design addressed these issues in several ways. First,

the visual environment presents both a high level view of the entire composition and its structure (the "*Project Space*"), alongside the specific locale that is being worked on (the "*Idea Space*"). Second, the Idea Space can be arranged to display the kind of views and amount of detail that provides the most appropriate feedback on the musical state. Third, sketches and placeholders can be inserted even where no music yet exists, to visually show musical intent.

The notion of *relationships* arose because composers mentally relate various materials within a composition in a number of ways. The composers thought it would be useful to visualize these relationships so that one could view the musical materials in relationship to some compositional process, and not only by the order in which they appear in the composition timeline. For example, composers often use motifs – recurring thematic elements. In most tools, the composer can copy a motif from one place and re-use it in another with a "linking" operation. However, if, as often happens, the composer alters the motif in some particular context, the link – and, in most tools, the relationship – is broken. Of course, these elements *are* related in the composer's mind: they are instances of the same motif.

To address this problem, our music representation provides "ancestry links" that point from the copy back to the original. When a musical fragment is copied and pasted, an ancestry link is created. The composer may adjust each motif instance to the surrounding musical context and the system retains this link, even if the music ultimately differs substantially. The composer can later query the system to see all recurrences of a given motif. (see Figure 6, Figure 8).

It soon became apparent that there are many other kinds of relationships that would be useful to establish, both *episodic* and *semantic* (functional). An *episodic* relationship associates an object with a certain concurrent or coincident activity. For example, a composer may not remember in what folder a certain melody patch is stored, but may be able to recall what scene of the film was showing when he first improvised it. The scene is thus episodically related to the melody. A *semantic* or *functional* relationship connects objects that relate by a certain function, such as an expressive curve and a musical phrase, and its presence directly affects the final result. *Containment* relationships create a hierarchical structure, such as a violin melody within the string section in the second movement of the piece. A *Process* relationship indicates a sequence of actions that was used to shape musical material, such as a transposition, filtering, or inversion. *Referential* relationships indicate, for example, the places where a musical entity is used, such as all the appearances of a given motive. In addition, the composer may want to create her own *categorization* relationships for grouping different objects together in a way the composer finds meaningful.

The above ideas impacted our design in that the underlying music representation had to provide for establishing relationships without their being functional, and the user interface had to provide visualization and navigation facilities for managing them. Note: well after our basic design was established, we discovered that our taxonomy of relationships was similar to classic cognitive models of memory organization. (Tulving 1972) first distinguished between episodic and semantic memory, and later (Tulving 1987) added procedural memory as an additional class (along with propositional memory, which encompasses episodic and semantic memory). Our notion of episodic relationships corresponds to episodic memory; our Process relationship corresponds to procedural memory; other relationship categories all relate to semantic memory.

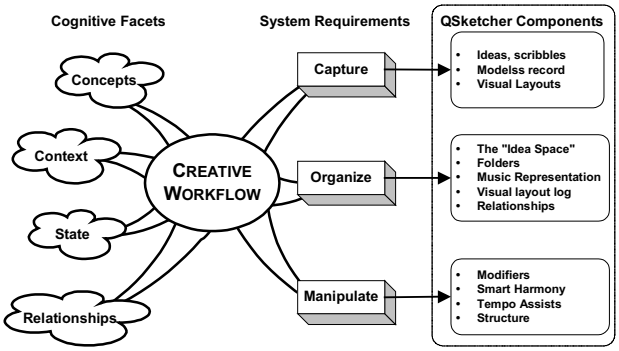

Figure 1. Overall cognitive aspects and system requirements, and related QSketcher components

The diagram in Figure 1 summarizes many of the points discussed above and identifies some relationships between the requirements of creativity and system components. It is important to note that in reality the relationships are more complex than indicated in the diagram – most system components relate to more than one workflow stage or cognitive facet (Oppenheim 1991). The following sections will discuss the system from the perspective of the workflow: capture, organize, manipulate, and context. We will end with a discussion of the important aspects of the music representation that reflect and support these ideas.

3. The Composition Environment

The design of our environment is rooted in several simple observations:

- Balancing opposites is a way of life for creators: inspiration vs. perspiration, top-level structure and form vs. minute details, sketching vs. refining.
- Creators have many different work-styles: no single approach or process is sufficient. We need to support "structured noodling" as well as formal construction
- The workplaces of creative people are generally littered with meaningful arrangements of "stuff."

To accommodate widely varying work-styles, the tools and environment should be both flexible and easy to customize. This is often much more important than the sheer power of each tool: if they are hard to use (or discover, or access when you want them), power tools give little benefit. And it is important to have tools that work at each of the various levels – fine editing tools as well as gross or structural manipulation tools.

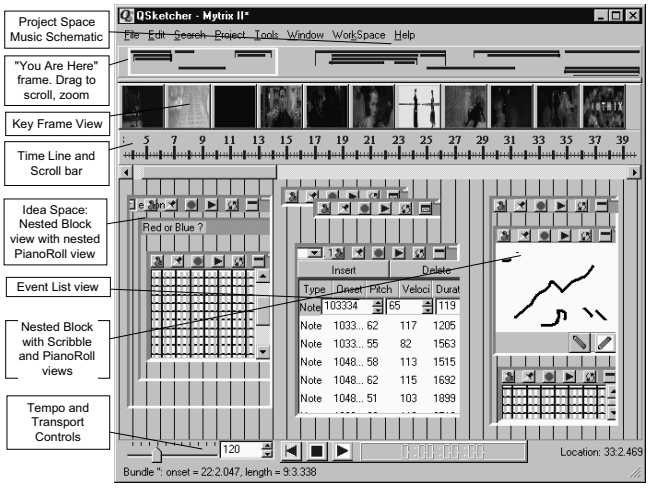

Figure 2. The Idea Space and Project Space

Our environment is divided into roughly three parts: the *Project Space*, the *Idea Space* and the *Database Palette*. The *Project Space* manages project-level information, activities and navigation. This includes foldable schematics of the music and visual structure (which can be very different), as well as more traditional high-level film context (overall timeline, important time markers, video 'key frames'). The *Idea Space* provides the project's main "work surface". The Idea Space embodies a "boundless sheet of paper" metaphor, in which time runs from left to right. Content of all forms (music, post-it notes, scribbles, control curves, compound assemblies...) is captured, displayed and manipulated on this work surface, in a user-defined arrangement of nested views. Some of this content is playable; other content is simply presented for reference. The Idea Space is also used for managing the project's hierarchical structure. Three kinds of view modes (*Embedded*, *Pinned* and *Floating*) clearly distinguish between project content seen "in time", context-sensitive expanded and referential views of content, and free-standing tools and palettes. We discuss this further below

The *Database Palette* holds all kinds of material: raw materials and finished sections; quick sketches – potentially any system object including cue sheets and phone logs, tool configurations and visual layouts. The Database Palette includes facilities for browsing or searching through content, and is described in more detail in section 5.

QSketcher provides several ways of presenting musical and music-related content. You can view a musical entity as a block-oriented structural view, as a "piano roll" event display, as a textual event list, as expressive curves (e.g., tempo, pitch, volume), or even as sketches and textual annotations. Any or all of these views may be displayed simultaneously. QSketcher affords the user considerable flexibility in arranging these views so as to display exactly what the composer needs to see, where and when he or she wants to see it. For example, most views can occupy very small amounts of screen real estate, by adjusting the amount of information displayed, facilitating the transition from macro to micro level work.

QSketcher is designed to help the composer visualize their mental context by several means. The Project Space visually presents the global compositional structure as a compact "Music Schematic," showing the top 1 to 3 levels of the content hierarchy. A separate "Film Schematic" presents the global structure of the film, showing the structural counterpoint between film and score. A highlighted rectangle (the "You-Are-Here" view) on the schematics shows the portion of the composition currently visible in the Idea Space. This rectangle can be manipulated directly to effect scrolling and zooming.

QSketcher provides a novel mechanism for viewing content in or out of temporal context. Normally, a content view appears within the Idea Space so that the left side of the view rectangle indicates the content's onset, while the rectangle's width indicates the content's duration. We call this an *embedded view*. Moving the view rectangle changes the onset of the content; resizing the rectangle changes the content duration (by manipulating tempo, changing a loop or repeat factor, or perhaps clipping start or end of the content). In short, changes to embedded views directly affect the composition (and appear immediately in the Music Schematic). Most importantly, the contents of an embedded view are tied to the indicated point on the film timeline, and are rendered at the specified time relative to the containing section.

However, it is often desirable to view a piece of music content out of context, e.g., to examine a section near the start of the composition while working on similar material in another section, or to expand a view for detailed editing purposes. For such purposes, we provide *pinned views*. A pinned view is in effect a duplicate view that can be arbitrarily resized or moved without affecting the temporal properties of the corresponding content. The term "pinned" derives from the fact that these views are attached (pinned) to a specific time location in the composition. Thus, scrolling the Idea Space causes the pinned view to move, disappear and reappear just like embedded views. Unlike embedded views, pinned views are *not* rendered when the containing section is played. Pinned views act as if you literally pinned a copy of some content onto the score, and may be collapsed to conserve space if desired. Composers may use a pinned view to show a relationship between two pieces of content – and as another reminder of context.

Finally, QSketcher provides *floating views*. A floating view is like a pinned view in several ways: it may be collapsed as needed, modifying its geometry has no temporal consequences, and it does not get rendered when the composition is played. However, unlike pinned views, a floating view is not anchored to a particular project location, but rather to a screen position. Thus, scrolling the Idea Space has no effect on floating views; they behave as if literally pinned onto the screen. Since views can hold tools as well as musical content, this provides a very flexible means for organizing the workspace.

The compositional process frequently requires shifting from one focus to another. For example, one may start by working on the melody, which then leads one to change the harmonic progression, which alters the harmonic rhythm, which in turn leads one to consider alternative rhythmic skeletons, and so on. Each of these activities might be best carried out with a different arrangement of views and tools.

Our system addresses this need by providing simple ways for capturing and recalling a snapshot (configuration) of the set of views, including tool configurations and the portion of the composition (or the database) that they were viewing. One can have many such snapshots available at any time for recall at the click of a button. Unlike other systems, it is not necessary to explicitly save a snapshot. QSketcher automatically captures a snapshot whenever it detects that significant changes have occurred. (A short time delay is used to avoid capturing many almost-identical snapshots.) We call this the "You Were There" feature.

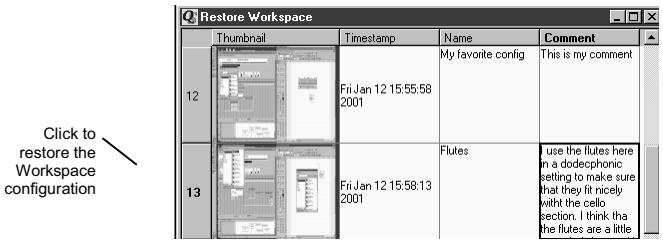

Figure 3. The Workspace configuration Log

The snapshots (whether manually or automatically captured) appear within a Workspace Configuration Log; each snapshot is represented by a thumbnail graphic of the screen layout along with the wall-clock time and project time position when it was captured. Comment and title fields are provided for optional annotations by composers. The log may be sorted by any field; we hope to provide further sorting and retrieval mechanisms in future.

4. Capture

Ideas come in many forms, at any time, particularly in the early stages of a composition. Moreover, their usefulness is often not obvious a priori, but rather, becomes evident only later. Unfortunately, ideas are also evanescent, disappearing if you take too long to capture them. As (Stravinsky 1942) put it, "In the course of my labors I suddenly stumble upon something unexpected. This unexpected element strikes me. I make a note of it. At the proper time I put it to profitable use."

Therefore, we adopted the following design principles:

- Nothing should ever be lost: all captured content should go into an "Infinite Take Vault." Content should be annotated automatically, to preserve its original context. Disk storage is cheap; good ideas are priceless.
- The system must support many kinds of content, with modeless or near-modeless capture
- Facilitate concurrent user activities and "constructive noodling" (unplanned improvisation).

QSketcher's capture mechanisms are novel in two ways. First, we recognize that hand sketches, graphics clips (e.g. still frames extracted from video), audio clips (e.g. music or recorded conversations), textual annotations, musical fragments and skeletal compositional elements (e.g. A-B-A structures), all participate in the creative process. QSketcher can capture each of these forms of ideas, and allows the user to place them in the Idea Space, serving many possible uses:

- fragments, improvisations, or musical sketches leading to the final work
- visual cues of compositional intent
- placeholders for future work
- several perspectives on the same musical entity

Second, our capture mechanisms provide a fluidity that few environments offer, by virtue of both the "boundless paper" metaphor and their nearly modeless behavior. Thus, the user can watch the film while sketching in the Idea Space, playing on the MIDI keyboard, typing notes, whatever is appropriate. The system captures the ideas, along with relevant contextual information. For example, to record from a MIDI keyboard, one simply begins playing without explicitly entering 'record mode'; the system actively listens to the MIDI ports at all times and records everything played. The recorded material is stored in the database's "Take Vault" folder, and annotated with creation attributes including the wall clock time and project location. If the Idea Space has an active insert locus, the new material is also inserted as a new block at that location.

By extension, to sketch a tempo curve, one should simply be able to pick up the mouse and begin drawing on a block's background; to create a post-it note, one should simply begin typing. Clearly, this could introduce ambiguity in interpreting gestures. Clicking and dragging the mouse could signify that the user wants to draw a shape, create a selection, or move an object. The ambiguity might be resolved by the choice of input device, as an extension of the above paradigm, which uses the MIDI keyboard exclusively as a recording device. For example, a graphics tablet could be reserved for freehand drawing and gestural control (Wright et al 1997); the mouse, for selection and direct manipulation. More work is needed in this area.

5. Organize

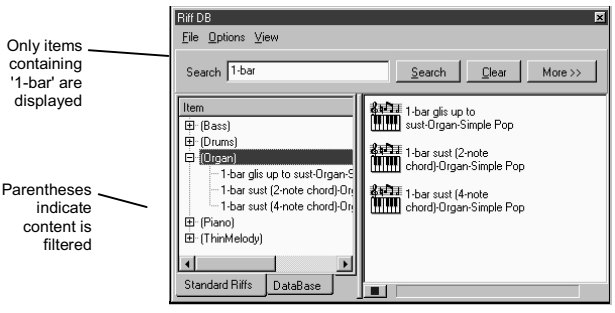

Figure 4. The Database Palette(Query Mode)

Creative workers often suffer from "content overload." Working with a system over an extended period of months or years, or with large numbers of samples or other canned materials, it often becomes exceedingly difficult to locate the right content to use as raw material for another composition. To help combat this problem, QSketcher was designed with an integrated "database" that can house any kind of content: entire compositions, melodic fragments, chord progressions, and so on.[1] This is possible in part because the database is built using the same kinds of objects that the system uses to build compositions.

To make the database search mechanism even more useful (while avoiding undue burden on the composer), QSketcher automatically captures contextual information as objects are created or modified. This includes wall clock time, project timeline location, containment hierarchy, ancestry (from which an object derives) , etc.

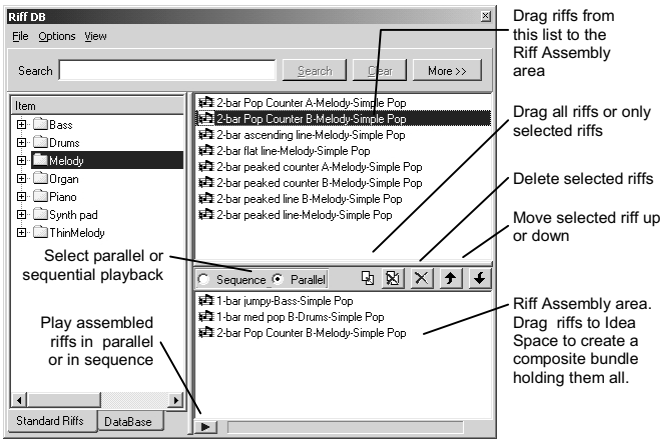

Figure 5. Database (DB) Palette: Riff Assembly area

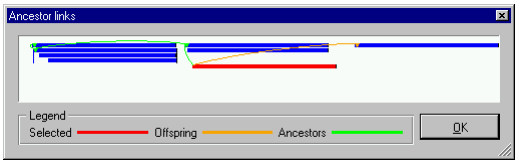

Figure 6. Ancestry Links Display

The database provides several basic functions. First, it allows you to find anything stored in the system (even outside the current composition) by qualitative queries on attributes. The mechanism supports searches on:

- creation or modification date/time ("last Thursday")
- name of the musical fragment

Slated for future implementation are searches on many other attributes, including:

- arbitrary symbolic tags ("happy")
- musical attributes, such as key, tempo, instrumentation, melodic fragments, chord sequences
- where it was used (in what compositions and where within)
- the portion of the film that was displayed while the riff was originally captured

Search results can be displayed either as a flat list, or in hierarchical context. The database was designed to allow the composer to create his own hierarchical organizations of material that exist alongside the system-defined ones. For example, one can create a database folder called "My Cool Bass Riffs" and place music blocks into that folder. The user can also create multiple database views, each displaying a different portion of the database. Each view can navigate and browse the database, or the results of any search.

The database palette naturally provides a means for auditioning the content, but adds a unique "assembly" area allowing the composer to experiment with arrangements, grooves, counterpoints, etc. and drag the result off into the composition (see Figure 5).

6. Manipulate

The need to manipulate musical materials is obvious, and many tools exist for this purpose, such as piano roll editors, event list editors and the like. While these are certainly useful (and QSketcher provides them), we believe strongly that tools also need to directly model and expose higher-level musical concepts. Unfortunately, such tools are somewhat rare.

Our earlier work demonstrated the use of graphical shapes to modify musical aspects, such as melody, amplitude, or tempo (Abrams et al. 1999). Shapes can be applied anywhere in the compositional hierarchy and modify the music in subtle ways by specifying expressive detail, or by transforming the underlying score into what is perceived as new musical material. Our representation of functional tonality enables us to apply these tools on pitch while retaining the functional relationships; i.e. the music remains pleasing to the ear (Abrams et al. 2000).

For QSketcher, our emphasis was on the issues of creative workflow (e.g. the Idea Space, visual layouts, context management and the like). More extensive manipulation facilities will be added in a later phase. As noted above, basic event editing tools are now in place; manipulating the compositional structure is supported in the Idea Space and Music Schematic.

Composing for a visual medium involves the special challenge of managing the relationship between time and frames, and the fact that this relationship often changes during composition, as film editing progresses. Thus, the composer needs high level tools to adjust the music accordingly (again using macro and micro tools as needed).

QSketcher provides several novel mechanisms for dealing with time. First, each bundle in the Idea Space can have its own tempo map and time signature. Second, a bundle can be stretched by dragging its right-hand boundary in one of two modes. Using the left-mouse button to drag, modifies the bundles length, leaving the tempo unchanged.

[1] In fact, the database can theoretically house rhythmic skeletons, tool configurations, and view configurations, but we have not yet exposed this ability to the user.

Using the right-mouse button scales the bundles tempo map, thus modifying the bundles effective duration.

The timeline also supports markers bound to specific time locations. Dragging markers with the left-mouse button alters their temporal position. Conversely, right-mouse dragging modifies the tempo map: if the map had a change at that location, the corresponding tempo is modified; otherwise, a new tempo change is introduced.

One can also align markers with key-frames in the Film Strip by simply dragging the marker onto the desired key-frame. This has one of several effects. If the marker is a bundle-beginning marker, the bundle's onset is changed to reposition the bundle at the marker time. If the marker is a bundle-end marker, the bundle's tempo map is scaled (if possible) to make the bundle end at the given time. If the marker is in the middle of the bundle, the tempo map is modified (by inserting a tempo change, if necessary, or altering an existing change) to align the marker with the key-frame. Finally, key-frames can be dropped onto the time-line, thereby creating a new marker and performing a similar tempo-map modification.

7. Music Representation

Clearly, a music representation (i.e. a set of data structures) that directly models the key concepts makes implementing all of the above easier. Our music representation is essentially a best-of-breed design, incorporating those features that facilitated support of composer-requested features. ((Dannenberg 1993) provides an excellent overview of music representation issues.)

Given the requirements of capturing all forms of ideas and organizing them in a common environment, we designed our representation based on a small number of general concepts. All materials – textual notes, modifiers, phrases, motives, graphical sketches, etc. – are "bundles", and are stored and manipulated in the same ways. This flexibility allows the database to store different kinds of content, allows pinned and embedded views of anything to be placed anywhere, and so on. In fact, database folders are also bundles. Certain bundles (MusicBundles, for example), are "specially marked packages," i.e., derived classes that add accelerator methods for common properties (e.g. Note's GetPitch()), and provide semantically-important processing beyond raw property access (e.g. Note::GetPitch() can take modifiers and context into account in computing the pitch).

At the heart of our music representation is a "free-form" mostly-hierarchical structure of "bundles". The system does not force track-oriented, notation-oriented, MIDI-specific or other overly constraining models on the music (although the system is capable of representing all of these possibilities). In particular, this permits the creation of skeletal compositional structures, and is a natural match for the free-form "blank-sheet-of-paper" paradigm of the Idea Space. The composer team felt this was a key component of the system's ability to support a fluid work style in the early phases of the composition process.

Every bundle and note is a property bag, i.e., an association of symbols ("interned" strings) with properties. All musical data and meta-data are represented by properties. Valid property types include strings, symbols, numbers, booleans, pitches, temporal locations/durations, instrument descriptors, expressive curves, time-sorted event lists, wall-clock timestamps, images and references. Any client can add properties to a bundle. This feature allows the composer and the various tools to add both functional data and arbitrary annotations to bundles as well as to folders in the Database Palette. The current implementation is reasonably time- and space-efficient. Figure 7 illustrates the use of properties in a small compositional structure.

Properties can be "inherited" by child bundles from parent bundles, and overridden if desired. For example, a child can inherit or override tempo from its parent. Modifiers (see below) are also inherited, and provide a powerful, high-level mechanism for altering and shaping content in child bundles from enclosing contexts.

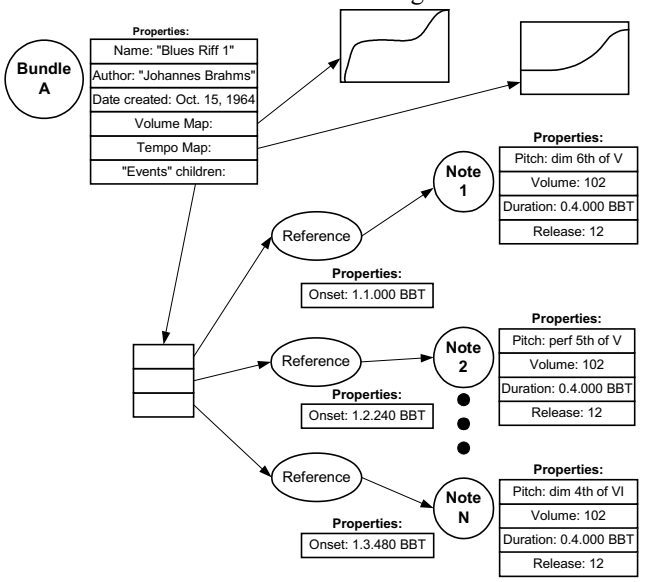

Figure 7. Property and Bundle Representation

"Colored links" are used to represent all of the various relationships among bundles. For example, parent/child relationships in event lists are represented using links of "event color", user-defined database folders' contents are indicated with links of "folder color", and the ancestry of copies is recorded using "ancestry-colored" links. Any client can add links of arbitrary colors, and navigate the content using these links. The search mechanism in fact uses the same code to scan through database folders that it uses to scan through the composition hierarchy. Figure 8 illustrates the use of links in a compositional structure.

A bundle in the hierarchy can be a *reference* to a *shared* musical entity, such as a motivic riff or melody. References are themselves property bags and can therefore augment or override properties of the shared content. This was originally designed to support motivic reuse, while retaining the possibility of customizing each reuse. For instance, a

shared bundle's content could be interpreted within two distinct harmonic contexts (or tempo maps) provided by two different parents (see Figure 8). However, our composer team felt that copy-to-modify was sufficient, given the ability to trace the "ancestry" of copies. So, in keeping with our mantra "the composer is always right", we did not expose shared references in the user interface.

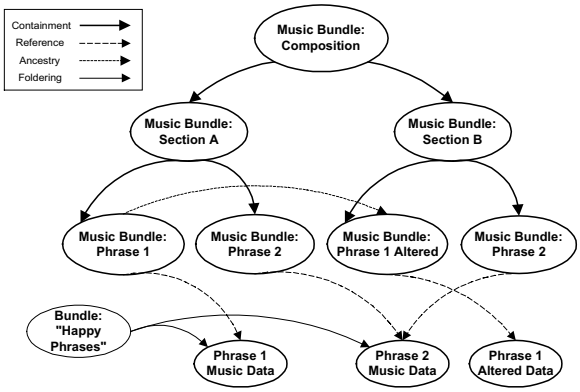

Figure 8. Bundle and Reference Representation

The music representation is easily instrumented with our pitch representation (Abrams et al. 2000), which embodies a basic model of Western tonal music. This supports "smart" transpositions, harmonic transformations, and melodic shaping, while preserving functional aspects of harmony. Expressive curves ("modifiers" (Abrams et al. 2000)) can be used to modulate any numeric parameter, such as pitch, volume, onset, duration, or tempo. These curves are a key part of the conceptual framework that our composer team described in the early compositional process.

The system supports several different types of time: bar/beat/tick, SMPTE, microseconds, and audio samples. A note's onset, for example, can be specified in any form of time that is defined within its context, i.e., within the enclosing bundles. This ability is key to describing, e.g., musical content with a metric structure (bars/beats/ticks), locked to specific SMPTE frames within the film, one of our composers' core functional requirements. As a further illustration, a bundle with a metric structure can hold a note whose onset lies on a particular frame, to align the note with a particular film event, regardless of tempo changes. Compound representations such as bar/beat/tick can house a mixture of positive and negative quantities, allowing the expression of "50 ticks before beat 2 of bar 3".

Music representation objects issue notifications to interested clients (e.g., the user interface) for relevant events. For example, property bags (notes and proper bundles) emit notifications as property values change. Since event lists are properties, adding and deleting children uses this mechanism to keep clients updated.

8. Conclusions and future work

We have outlined a new compositional system that is novel in three ways. First, its design is strongly rooted in musical concepts. Second, it supports the compositional workflow in several ways: by helping the composer to capture ideas, to organize those ideas to focus on the essential aspects, and to manipulate those ideas in intuitive ways. Third, the system helps the composer to keep track of her state-of-mind as he shifts from one activity to another.

The system is an work-in-progress, but the composers involved in this project are actively providing valuable feedback and helping us to refine it, and to maintain the conceptual focus where it belongs: on the composer.

In music, as in many other domains, information technology tools can have a significant impact on the creative process. Tools can reify certain artistic practices, while marginalizing others. That is, many tools encapsulate the particular practices used (or witnessed) by the tool developers, and force users to adopt that terminology, structure, and even workflow. When this happens, the tool is certainly influencing the worker - and, most likely, limiting his ability to explore the space of creative possibilities. In this research, we identified some techniques that help prevent this common pitfall, freeing the composer to explore the musical space, think and work in common musical concepts, and freely move among the various modes of work in a fluid manner.

More generally, we have found the music domain to be an excellent vehicle for developing new metaphors and mechanisms for supporting creativity, and believe that these ideas apply to many other domains. The key aspects of tools needed to support creative workflow (i.e. capture, organize, and manipulate), and the ways in which they relate to the cognitive aspects of creativity (i.e. context, relationships, state, and domain-concepts), have the potential to grow into a general model for framing research and development in tools that support creativity across many domains.

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Interactive sound works in public exhibition spaces, an artist's perspective

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Abstract

This paper explores the research and responsive environment installation works developed over the last five years by the Australian composer/installation artists Garth Paine . It addresses the area of responsive environments within the scope of an artist interested in using interactive sound to encourage a consideration of our relationship to our environment. The issue of public interpretation of the artworks is discussed, and in so doing the idea of a performance practice for interactive sound works is explored.

Context

The focus of my research over the last two years has been in the area of responsive environments. The area of interactive sound systems can be loosely categorised into three differing approaches:

- Gesture based interactive instruments
- Virtual Reality
- Responsive Environments

The differences in intent are marked.

- Gesture based interactive instruments can be seen as a developed of the acoustic instrument, performance paradigm. These include a number of interfaces developed to mimic existing instruments, (such as Leonello Tarabella's piano interface), or to take existing instrument gestures and apply them to new synthesised output (see the work of Tau Tanaka and Sensor Band amongst others)

- Virtual reality (VR) tends to be focused on the creation of an immersive audio and visual environment. These environments are predetermined. They contain a limited number of paths or scene transitions the user can traverse. They do not provide a realtime generation engine that provides audio and visual stimulation unique to each user. VR pieces require the user to don sophisticated hardware

interfaces that mediate ones presence and interactive potentials. They require a degree of familiarity with the hardware, and a learning of the interface. Virtual reality is illustrated in the work of Brenda Laurel, Christa Sommere and Laurent Mignonneau amongst others.

- Responsive Environments can be based on realtime synthesis engines, obviating the need for pre-made content. They do not require the wearing of hardware to interface with the system, and as such provide a high degree of flexibility, and encourage individual movement patterns. The freedom of interaction and the ability to produce outcomes in realtime, make the responsive environment unique in its ability to generate truly individual outcomes. Responsive Environments are illustrated in the work of Myron Krueger amongst others.

My work has been based in the area of responsive environments, because my research goals have been to explore forms of interaction that contain as few predetermined factors as possible. I have focused on systems that directly reflect the uniqueness of individual participants' input.

Artistic Intention

As an artist my interest lies in reflecting upon the human condition. There are many aspects of our lives, and many facets of international relationships between differing cultures, governments and philosophical persuasions that we simply do not take the time to consider in our day to day lives. Addressing these issues on some level however is vitally important to the continuing co-existence of the many disparate parties that form the global community, and integral to the further development of understanding and insight into the relevance of differences within the global community.

I see art as the perfect platform for the consideration and expression of these issues. Visual artists, writers, dancers and musicians have explored these issues for centuries with profound results. One only has to look at the prestige attached to the great cultural institutions of the world to see that the product of this artistic endeavour has communal value. One might argue that the value attached to these institutions is purely financial, that the value placed upon the works they contain is a product of contrary economic principles - of course the economics of historical value play a part in their financial value. It would however, be far too cynical to contribute their communal worth solely to the financial market place. If that were the case, the works would be housed in private environments for private enjoyment, not in public institutions, accessible by all.

If we agree that these works have a communal worth, we in turn agree that artistic endeavour is of value to society. As I have pointed out, this case is already proved for the traditional artforms, writing, music, dance and visual arts (painting and sculpture).

One of the interesting questions is:

- How do we develop an understanding of the way in which new artforms fit into this theory?

The explosion of computer based technologies in the last forty years has resulted in many new forms of expression. To some extent, the reduction of all material to a binary base of zeros and ones dissolves the borders between the artforms. In fact a software algorithm

that is used to process sound may also be applied to visual material, although with dramatically different outcomes.

This reduction of all materials to binary soup has both advantages and disadvantages:

The advantage is that the synthesis of aural and visual events is possible. The artists can write an algorithm that produces a sequence of zeros and ones that generates an outcome descriptive of something that occurs in the natural world, or for that matter, something that has never, and may never possibly occur in the natural world.

For me though, the excitement of this ability to turn anything into a digital soup, is the potential that lies in the treatment of material gathered in the natural world. The digital domain facilitates the subversion, expansion, dissection, and general exploration of the "real world" material. It allows the artists to search the, until now, hidden aspects of the material for new expressions. A sound for instance has an outer face, that we may be familiar with. However, if one starts to dissect the sound, it exhibits many layers of interacting vibrations that can be teased out. Once the artist has control of these individual aspects of the sounds character, it becomes possible to accentuate the hidden characteristics, or to peel away the outer facade like an onion skin, thereby revealing finer and finer nuances.

The computer-based arts have been stymied by the complexity of the programming required to generate even the most simplistic and subsequently relatively boring image or sound. Nature in its wisdom in infinitely complex and variable. Naturally occurring sounds are often made up of extremely complex combinations of partials which vary over time in elaborate ways. These variations are determined by the many environmental factors present in any momentary event.

Fortunately technological developments are currently so rapid that the speed of desktop computers has accelerated exponentially - the Apple Macintosh G4, presents specifications that only a few years ago were the domain of the super computer. The Apple Macintosh G4 or the Symbolic Sound Capybara 320 systems both provide the ability to generate audio in realtime that reflects the complexity inherent in nature.

This relatively affordable computing power has allowed artists like myself to move from *off-line* image and sound generation to realtime synthesis. Whilst this may not appear overly exciting, it has precipitated a much more profound exploration of the genre of interactivity.

Real time computation has allowed interactive arts to create realtime causal feedback loops.

The exploration of the cybernetic paradigm of feedback loops has been the focus of my installation works **Moments of a Quiet Mind** (1996), **Ghost in the Machine** (1997), and with the development of realtime synthesis engines, in my recent works **MAP1** (1998) and **MAP2** (1999/2000) and **REEDS** (2000).

MAP1 is an interactive sound installation commissioned in 1998 by the Next Wave Festival, Melbourne, Australia. **MAP1** uses realtime granular synthesis of live audio input as the interactive sound response. The sound is gathered using a microphone in the installation space. The granulation process (generated in SuperCollider on a Macintosh computer) is controlled by gesture analysis of people within the installation. The gesture analysis is carried out using the Very Nervous System (VNS - developed by David Rokeby), and a small black and white video camera mounted in the roof of the gallery. A

MAX patch converts the variations in light intensity per pixel per video frame reported by the VNS into MIDI continuous Controllers (MCC). These MCC values are sent to the SuperCollider patch using the OMS IAC bus.

The granulation process uses a cycling audio buffer as its source. The audio buffer is overwritten when sounds made by its participants exceed a certain threshold. The audio buffer is overwritten for the period the sound remains above the threshold. This provides the opportunity to work with sounds entered by other participants (past or present), or to enter one's own sound sources

MAP1 therefore provided an environment in which the sounds made within it are resynthesised in response to the quality of the movement and behaviour patterns sensed by the system. The possibility for unique system responses is multiplied by the gathering of individual's soundings, and the analysis of individual gestural motion as the source of the resynthesis. In these ways **MAP1** provided a tight relationship between the input of each participant, and the system response. No pre-made material is contained in this installation.

Pierre Boulez describes composition as a selection of notes derived from a finite predefined set.

Trevor Wishart (On Sonic Art) points out that contemporary composition, especially within the genre of electronic music, goes well beyond "*a finite lattice and the related idea that permutational procedures are a valid way to proceed . . . ".* Wishart proposes a *"musical methodology developed for dealing with a continuum using the concept of transformation".*

The concept of a stream of constantly evolving sound is directly supported by the use of realtime sound synthesis. The ever evolving - sometimes audible, sometimes not - processes of data driven art follow the Wishart approach. The Boulez approach is more closely aligned with the commercially prevalent paradigm of interactivity as a response to a defined challenge with a prespecified finite outcome, such as the triggering of existent sound files.

Realtime synthesis provides a subtle but profound alternative. The use within the synthesis instrument of variables controlled directly by movement gestures provides a way of not simply creating a personalised mix of existent sound samples - much like a DJ - but of creating a completely unique sound stream. The temporal form as well as the pitch/timbre and "orchestration" of the score are created in realtime by the user. In my opinion, this freedom of response creates an individualised outcome that so tightly reflects the actions of the user as to be both qualitatively and quantitatively superior to an installation utilising pre-made sound sample events.

An installation using existent sound samples can be made to reflect user input by varying the playback polyphony, sample choice or small amounts of pitch bend. These relatively course reflections of control input does not reflect small intricacies of movement in as symbiotic a manners as realtime timbrel, envelope or modulation variations.

MAP2 features the concept of stream driven interactivity within an exploration of pure synthesis. **MAP2** was commissioned by the *Staatliches Institut für Musikforschung* (SIM), Berlin, and was exhibited at the Musical Instrument Museum, Berlin (Dec 1999 - Jan 2000). **MAP2** was developed in collaboration with Dr Ioannas Zannos.

MAP2 is based on a video sensing approach (using the VNS), that divides both horizontal and vertical planes into numerous independent fields. The horizontal plane is divided into four independent zones, each consisting of thirty-two fields, reflecting four different synthesis instruments, active at different thresholds of activity, and played by positional information provided. The vertical plane is defined as a row of interactive fields at a little over head height. These vertical fields control the playing of a physically-modelled plucked string sound.

The performance of **MAP2** is controlled by data gathered using the VNS. The horizontal space in **MAP2** was divided into four sections to enable participants to determine their own distinct input when playing the installation with others. This development was a response to feedback from users of **MAP1** who sought to clearly identify their own contribution to the interactive sound environment. Each of the four quadrants of the **MAP2** installation were totally independent, being controlled by separate data streams and addressing separate synthesis processes.

The research developments illustrated in **MAP2** are

- the simultaneous sensing of multiple interactive subjects with independent control over separate synthesis processes
- the sensing of the physical space as a 3 dimensional cube, applying separate video analysis to both the vertical and horizontal planes.
- the provision of multiple asynchronous synthesis processes, each with multiple synthesis instruments responsive to varying thresholds of movement activity.

These changes in the structure of the installation provided a many fold increase in the complexity of possible interactive responses over the **MAP1** installation. **MAP1** provided a single synthesis process for all interactive input for the entire physical space.

MAP2 marked a progression towards multiple asynchronous feedback loops - one for each division of both the vertical and horizontal sensed spaces, and one division for each of the synthesis instruments available within each threshold range of each horizontal field.

MAP2 also provides more variation in sound aesthetic and "*orchestration*" by virtue of the greater number of synthesis algorithms available, and the ability of the system to allow 4 people to interact simultaneously and asynchronously.

Whilst the change in dynamic of sensed movement causes additional synthesis algorithms to become active, the position of the sensed body causes variation in resonant filters placed in the signal path just prior to the each of the 8 independent audio outputs. The audio signals were sent to the output assigned to the loud speaker closest to the position of the sensed activity. This technique caused the sound output to track the interactive behaviour through the physical space, two speakers being allocated to each of the quadrants specified in the horizontal video sensing set up.

My most recent work, **REEDS** was presented as part of the Melbourne International Festival of the Arts, Melbourne, Australia in November, December 2000.

REEDS extends the approach to complexity of interaction illustrated in **MAP2** by providing eight simultaneous but asynchronous data inputs. **REEDS** changes the focus of the past works by moving away from the human body as the central controller to the adoption of momentary weather conditions as the data source. **REEDS** uses two weather stations, both collecting the following data:

1. Wind Direction
2. Wind Speed
3. Solar Radiation
4. Temperature.

The data is transmitted back to a land base, where it is parsed and directed as MCCs to a SuperCollider patch, containing six independent instruments (two stereo and four mono), containing eight variables and creating eight channels of audio.

The use of momentary meteorological data allows the exploration of truly chaotic multifaceted patterns of interaction.

The weather conditions naturally scope the range of response. The chosen synthesis approach and the specifics of the incoming data mapping on to the synthesis variables generally establish the aesthetic.

The use of naturally occurring data patterns is a way of exploring both the concept of interactivity as a stream, and an attempt to discover techniques for more tightly linking the organic and human contexts with interactive systems.

The program notes I wrote for the **REEDS** project illustrate the central tenant of the work:

> *A weed, so easily crushed underfoot, can push its way up through a tarmac path, creating a sizeable fracture in what appears to us to be an impervious surface.*
>
> *One might postulate that if it could see the bigger picture, it might have decided to grow 2 feet to the left in the flower bed or the grass. There is clearly an analogy here to our own birth, which we seem to have little or no say in (depending on ones religious bent).*
>
> *It is exactly this chaotic behaviour of the natural world that informs the Reeds project. Whilst civilisation tries to harness or tame the chaotic in nature, or to explain it in terms of quantum theory and fractals, humanity cannot perceive a truly chaotic state. The forces of nature that dictate the growth of plant life fall into this category. It is not possible for us to predict with certainty the meteorological conditions from day to day, let alone year to year, and certainly not on the micro scale of the weed in the footpath. It is precisely these chaotic variations that are used in Reeds to conduct the sound score - to control and dictate the output of the real time synthesis process.*
>
> *Of course, the software design process predetermines the general structure and aesthetic of the sound, but the momentary output is unique. It is unlikely that the combination of wind speed, wind direction, solar radiation, and temperature that occur in this instance will be precisely replicated in any other moment. This chaotic variation is the very source of diversity, which I propose is the structure that creates such beauty in nature.*
>
> *Reeds uses the relatively static external facade of the sculptural form as a way of representing the paradox observed in organic plant life, where*

in contrast to the apparently static external face of the plant, is the hidden, dynamic activity of photosynthesis and nutrient gathering that keeps the plant alive.

The Reeds pod sculptures appearing as lifelike presences on the Ornamental Lake at the Royal Botanic Gardens Melbourne, support two remote weather stations. These gather wind speed, wind direction, temperature, and solar radiation data (the meteorological conditions, vital to the plants life processes). The data is transmitted back to a land-base where it is transformed into eight channels of musical sounds that are broadcast back out to the Reed pods. These sounds give a voice to the secret activity of the inner life processes of the plant.

The viscous and fluid aesthetic of the sound material is an attempt to capture something of both the dynamism of the life sustaining processes and the ever-changing, silken thread that is the presence of life, the life force itself. The fact that the sound material is generated on the basis of meteorological conditions is a way of drawing as tightly as possible the bond between the processes of nature and the processors of the Reeds installation. The sound material can not then be avoided, being the voice of the processes of nature.

Sound/music is in many ways a unique media, for it is not an external artefact. Sound literally penetrates the body. Furthermore, it is impossible to concretely tie composed sound or music to a representation of anything beyond a communication of emotional states and journeys.

As an artist my interest lies in exploring ways of contextualising digital art processes within the natural organic environment. I have little interest in the purely synthetic, that is the synthesis of sound or images from a wholly academic or theoretical viewpoint. I prefer instead, as is illustrated in the Reeds project, to take a fundamentally organic source as the basis for my sounds. In so doing, I hope that some quality of that organic material will permeate the work and thereby bring the synthetic output at least a small way towards the organic world, and therefore within the human context.

Conclusion

It seems appropriate to ask about the value of interactive new media art works. What do we take away from them? How do they enrich our understanding of the world? Do we continue to think about the experience afterwards, thereby developing a deeper appreciation of the ways in which that experience reflects upon our own lives? - As one does well after viewing a good film.

I don’t pretend that my own work has these outcomes, although, like many other New Media artists, I strive to create work that will facilitate these outcomes. I must also say that a new media art is no where near its zenith. There is much work to be done in

developing a language that communicates clearly and is sufficiently varied to accommodate the many individual artists working in the medium.

So I ask myself if the experience of these works is simply one of mapping the development of the art form, and in turn the evolution of the technologies, or an unbridled expression of artistic intent. I think that we are lucky enough at this point in the development of New Media art to experience both, however there are still many works that I experience, even at prestigious festivals that I think communicate little more that a technical achievement.

If new media art is to be taken seriously as an artform that has the capacity to communicate something of the metaphysical, we need to lose the technology - the technology that makes the work possible - the hours/weeks/months of programming, the innovative technical development. These aspects of the work, which are often revered as great achievements, needs to be translucent - conspicuous by their absence. The visitor/user should be unaware and unconcerned with the technology creating the experience. They should, however, experience a symbiotic relationship with the work that permits a real sense of freedom of interaction, and an infinite scope for self-expression and exploration. This is my goal, a goal I hope you see illustrated in the description of the work above.

In summary, I feel the most rewarding outcomes in responsive/interactive environments continue to be achieved through the exploration of realtime sound and/or vision generation. The realtime synthesis process reflects small intricacies of individual interaction. The participant feels directly acknowledged by this direct reflection of individuality. This in turn encourages a deep level of commitment to the exploration of the installations potential. Although technology has developed in leaps and bounds in the last decade, I feel computing power is just now sufficient for realtime interactivity. The current state of technology is encouraging for the development of this kind of work, We are living at a time that encourages realtime data driven sound synthesis through fast computing and excellent software tools.

We must shift our focus from technical achievements to a user driven experience. The technology must become both infinitely variable, and invisible to the end user.

The development of virtual reality technologies has shown a distinct partiality to the visual. In my view, sound is a much more direct and affective stimuli.

If we can make sound more responsive to individual interaction intricacies, I am sure we can prove responsive sound environments to be a superior form of immersive experience.

CIRCUS For Beginners

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0. Abstract

This paper describes CIRCUS, its origins, its main concerns, and a high-level view of some of its conclusions. One of the main issues was the way in which topics with their origins in the internationally misunderstood idea of 'culture' tended to predominate. While we take the view that our idea of culture is indivisible there are nonetheless subcultures, which seem to understand their own niches but little else, within it. Much of the head-butting in our deliberations came from this source. One source of cultural clashing which some observers tended to minimise was that between practice-based disciplines and knowledge-based disciplines. A good example was the distinction between the practice-based art and design community on the one hand and the more knowledge-based computer technology community (who nonetheless do a lot of practice-based work in their training) and we point to examples of clashes between these.

We make a particular example of the rise of the subculture which surrounds music technology, a new discipline within an old arts-and-humanities one. While there is plenty of evidence for the persistence of culture we also show that a careless spreading of carrots for starving donkeys can have unexpected cultural consequences. Music technology, which is more like computer science than, say, musicology, is now more likely to be found in engineering and computer science departments than in music departments despite the fact that it is a classical practice-oriented discipline with more structural similarities to design than computer science. The explanation is entirely to be found in the unexpected consequences of the way in which the subject is funded.

A major concern of CIRCUS has been the topic of 'creative pull' which is our favoured method of developing relevant technology for use by arts-based practitioners. Briefly 'creative pull' involves the development of relevant technology for furthering a creative practice-based project, so artists are in control and technologists derive their necessary insights from creative need rather their own overheated imaginings. We give some detail as to how 'creative pull' could be used to progress topics like nonphotorealistic rendering which have so far been driven largely by technological agendas. Finally after a bit of iconoclasm we develop some recommendations which could go into our final recommendations to the Commission, specifically in terms of mechanisms for promoting ad supporting projects with a 'creative pull' core, which are notoriously difficult to put together and get past the Commission's refereeing processes intact. Finally we discuss the vertical market model and show that many creative projects, particularly film projects, can effectively define an entire market for goods branded by the original film. These include pedagogical aids and knowledge packaged as a commodity, which in turn generates its own issues. A coherent model of creative pull can this have a quiet significant effect on geographically localised cultures and help to internationalise them. We argue in conclusion for a body to maintain a watching brief on 'creative pull' and to refine it from practical examples.

1. Origins

CIRCUS (Content Integrated Research For Creative User Systems) is an ESPRIT Working Group, originally set up in 1988 as one of the very last additional actions in Framework 4, under DG III. Its purpose was to develop models for collaborative work between artists (the term here used in its widest sense) ands technologists (ditto) and to promote these models by whatever means available. While some have criticised this aim as implicitly promoting a 1950s agenda of building bridges across C.P. Snow's 'two cultures', there is no such intention here, rather that technology, particularly computer and communications technology (ICT) , is irresistibly intruding into what is normally thought of as creative work (and so practised by artists) and that, like any new technique, this has to be understood by its potential practitioners in terms of its true strengths and limitations. The specific problem that computer technology poses is that it is in principle malleable to such an extent that the limitations on its form and functionality are still barely understood, yet the people charged with the task of making the technology available have little or no understanding of the needs of creative users. What the artist usually sees is a tool which is in principle capable of being harnessed to creative ends but in practice resists being so applied. Quite often the tool is shaped more by blind economic forces than by a clear response to a specific, here creative, need.

CIRCUS came into existence as a forum in which both artists and technologists could work out how best to play to the strengths of ICT and how to apply both creative and technological solutions (possibly both

together) to its limitations. In particular the then new Framework V programme invited projects in such areas as new media but required them to be addressed in essentially the same old way, by technologists working towards commercialisation. The only obvious exception to this was in the area of cultural heritage which, incidentally, CIRCUS was also capable of reviewing. The scope for effective participation by artists was thus limited by an essentially technological agenda although everybody at the time, the participants of CIRCUS and programme managers in DG III, believed that we could do far better than this, and to develop new models of working which could inform the nature of Framework VI or even the later stages of F V. It is fair to say that everyone involved was excited by the idea of doing something quite new (and iconoclastic), not least the expanding of the expertise base on which future Frameworks could draw.

It is also fair to say that, while not ultimately wholly original, the CIRCUS agenda was an ambitious one and the WG has had a chequered history peppered with misunderstandings perpetrated by the very people who might have thought would give the WG their strongest support. The CIRCUS idea has been aired before, specifically at the University of Illinois at Urbana-Champaign, the MIT Media Lab (and its imitators), and a recent IEEE forum. However a near total change in participation, fuelled by natural migration and a switch to DG XIII, has resulted in the CIRCUS agenda being restarted on at least one occasion and a fairly regular questioning of the principles on whose elucidation we are engaged. While this is no bad thing in principle, in practice we haven't learned anything new from these periodic bouts of self-examination other than a reinforcement of the values our goals. On the other hand it is evident that we have made progress and have moved on a long way from where we started. A recent experience of a workshop whose agenda appeared to be to form another version of CIRCUS, this time with an overwhelmingly technological (DG III) membership, demonstrates they have a CIRCUS-worth of work to do before they will have reached where we are now.

This paper aims to give its reader an understanding of where we have got to after nearly three years of deliberations within CIRCUS. We are currently engaged on the near impossible task of taking a reductionist approach to an essentially holistic activity, which is a probably unfair way of saying 'describing a culturally holistic pattern to a technological readership'. It is in reality an exercise in banging square pegs into round holes, but has the virtue of making the intangible graspable to an extent. We will proceed here by describing what we mean by culture and why we think it is important. In this we believe we are taking a EU-centric view, but it seems that the word 'culture' means different things to different people, so we must be clear. We then describe the sorts of interesting and useful questions where, while they require technological solutions, the answers would neither be understood by technologists in the necessary terms nor be posed by them in the first place. We then discuss means by which projects which could achieve these ends be structured, the mechanisms needed to support them, and the wider implications of structures to support creative activity which feeds technological development. Finally we discuss the role of the creative artist in a technological research context and the need for a body like CIRCUS to develop the agenda to the next stage. It is here that we will put to rest the final lessons we have learned in our 3 year journey around Europe.

2. Culture

Culture is a term which itself carries a different (cultural!) baggage depending on which European uses it. To a Briton the term usually conjures up what we should properly call cultural artefacts: music, literature, art, sculpture, also film, TV programmes and public media of all sorts, and basic assumptions about what we like (football, bangers and mash). Some more educated Britons might be aware that there was a long-running debate, now lost in time, about the 'two cultures' which referred to an essentially arts and humanities based culture versus an essentially science and technology based culture. There is an enormous amount of what even Britons would recognise as snobbishness about all this, for e.g. the elevation of music over film in the earlier list and, more subtlely, the separation of the intellectual cultures surrounding arts and science. C.P. Snow was the villain of the piece (a scientist, of course) and as you may remember he was a Cambridge don who spent a lot of his later life being savaged by another Cambridge don (F.R. Leavis) on the arts side (of course). Their spat even made it to the pages of 'Time' magazine and no doubt elsewhere in the 1960s and early 70s.

The reason it is all snobbery is because most people (now) recognise that the elevation of the University system (itself the embodiment of national cultures everywhere, and nowhere in England more than Cambridge which provides the UK with most of its 'establishment') has been due to Government support of scientific and technological research and probably would never have happened if Universities had failed to nurture the boom in hi-tech industries in respect of both the fruits of their research and the provision of the workforce to use them [Econ97]. While the arts provide us with most of the cultural things which give comfort to our lives no British Government would take the slightest interest unless there were big bucks in it for the economy over which they preside. (One could argue that this could indeed be the case for the systematic production of cultural artefacts but the economy is simply not geared up to exploit this.) Interestingly analyses of the perceptions of young people in Britain as to the social status of the various academic subjects put arts-based subjects at the top and the more mathematically rigorous subjects at the bottom. Engineering, in this pecking order, is the pits, and indeed many good Engineering departments around the UK are having great difficulty recruiting even a fraction of the students they attracted 20 years ago. More horrifically, something similar is happening in maths. So while the academic *raison d'etre* might be science and technology nobody wants to study them (with Computer Science as a notable exception because

students believe that you can get good jobs in CS –true – but think you don't have to know any maths to get there – false) and its impossible to recruit good researchers at the rates that Universities pay. There's always the odd lunatic though, and we're the ones who keep the system going - just about - so don't blame us when the economy goes down the tubes.

Our point is that Snow's position was really a political one, an attempt at establishing a different pecking order, with his profession, no doubt, at the top this time. Our position is different. We believe that our (European) culture is indivisible but finds its expression in many different ways. What is important is that every intellectual discipline has something to teach others but they often express what are essentially the same ideas in different ways. The analogy between computer programmes and knitting patterns has often been remarked on but how about computer game storyboards, musical scores, Jacquard Loom cards or statements in Church's Lambda calculus[1]? The answer is that all of these very different cultural artefacts embody very similar ideas expressed in almost unrecognisably dissimilar terms. What we are trying to do in CIRCUS is to develop collaborative models in which everybody is a first class contributor and this involves exploiting (understanding) what we all know and taking advantage of unique differences wherever possible. The outstanding obstacles have been language, definitions and discipline-specific conventions, and, it has to be said, the sub-cultures which surround these different disciplines. So we'd better get in with defining what we mean by culture as so far we've spent most of our time saying what it isn't.

What we mean by culture here are the tastes, preferences, skills, and accepted conventions of a self-perpetuating organisation of people. Research units, companies, universities, whole societies, all have their own cultures - all they have to be to develop their own culture is to have both a past and a future as a persistent and purposeful grouping of people. Details have been discussed extensively elsewhere [Pat99]. The point about culture is that all the evidence shows that, once established, it is remarkably persistent. Formal studies of measurable sociological indicators, such as that of the so-called ' democratic deficit' in Italy, point to a persistence in the value of those indicators over centuries, in some cases over 500 years. In recent times we have seen apparently intractable social problems driven by apparently irrational hatreds until one remembers that the *causus belli* is buried centuries in the past. It's the persistence of culture which makes the problems intractable, not logic or common sense (of which typically there is a notable absence). Here we are dealing with marginally more benign aspects of culture but always we have to reckon with its core characteristic of persistence.

In other countries like Germany the term culture carries with it slightly different baggage, again rooted in history. Germany as a unitary state is considerably less than 500 years old but from its foundation there has been a struggle between *Kultur,* the culture(as we understand it) of the East and *Cosmopolitanism,* the label given to the common culture of the West. In fact modern German history is incomprehensible to outsiders without understanding the nature of this struggle and the additional baggage that each version of German culture swept up with it in the late nineteenth and twentieth centuries. The end of the European wars in 1945 in effect put these differences back in the deep freeze and, only now with the collapse of Communism and the normalisation of the Eastern part of Germany, is the struggle resuming, fortunately somewhat muted through the extreme forces each strand has been subjected to in the meantime. For our purposes German cultural history doesn't offer us any useful lessons, other than demonstrating once again the persistence of culture and the only known methods of changing well-established cultural attitudes (very unpleasant ones, as Stalin demonstrated 1930-1953). Since Stalinist methods are usually considered unacceptable we need to learn to work with culture rather than futilely struggle to change it.

What we face in CIRCUS is really a spectrum of cultural conventions which, while they make dialogue from opposite ends of the spectrum difficult (and characterised by discussions which have a strong tendency to diverge and get nowhere), can provide far greater rewards than from what one might describe as intradisciplinary discussions. Examples of the sorts of things which CIRCUS can be quite proud of include its promotion of technology-oriented working models which are actually driven by creative need ('creative pull'), its comparisons between different pedagogical models and their mediation by technological means, and its investigations into creative data-paths and their promotion (which is the focus of the creative metadata discussions, vertical markets and open source models). This is by no means an exhaustive list and we would particularly point to several projects which have creative outputs or artefacts which are largely facilitated by technological means, including (again non-exclusively but notably) the collaboration between George Legrady and Timo Honkela ('Pockets full of memories'[Leg&00]) and several works by Malcolm LeGrice ('Chronos', 'The Cyclops Cycle'[LeG01]) all of which have been publicly exhibited.

As a consequence the idea that there might be cultural problems to be overcome has periodically been attacked within CIRCUS and elsewhere as being 'part of obsolete agendas' and it has been rather more subtlely argued that the convergence of technologically-oriented and technologically-mediated media will, indeed, make the agenda obsolete within a generation. The real problem is that the proponents of these arguments have indeed made the agenda obsolete - for them (and us), but this isn't the case when the context is widened. Two examples come to mind, the DG III workshop alluded to earlier and the experience described in Fred Moody's book 'I Sing The Body Electronic'[Moo95]. Since this book may not be familiar to many readers we should say something about it.

The book describes the experience of an author (Fred Moody) who was allowed to record a year in the life of the Microsoft Multimedia Publishing Group. At

[1] A mathematical formalism which defines functions operationally but predates automatic computation

the time (1993-4) multimedia publishing was an activity new to Microsoft and was carried out by a team made up out of designers (mainly from a creative arts background) supposedly collaborating with developers (all from a computer science background). There are many fascinating insights in this book but above all it emphasizies that the cultural integration we in CIRCUS take for granted simply doesn't exist, or maybe just evaporates, when developers and designers are thrown into a group willy-nilly and forced to come up with a product on a mainly impractical schedule determined by issues utterly unrelated to the needs of the product itself. Here the product was a children's encyclopaedia intended to be a stepping stone to Microsoft's (then) newly released Encarta encyclopaedia product. What made the schedule impractical was Gates' terror of what would happen to Microsoft's share price the instant their price/earnings ratio dropped below its then high mark-up. Essentially Microsoft was the victim of its own success[2]. What made any 'cultural integration' disintegrate was the mutually unhelpful perceptions the two groups, designers and developers, had of each other. Moody constantly reminds us how young they all were (this mainly because he thinks they didn't have the experience they needed to manage their individual character flaws). In fact they were the very people whom it has been suggested would be culturally integrated because of their exposure to both ends of the cultural spectrum, admittedly at the time a minority but so exposed by the professional paths they had chosen and the fact that Microsoft had picked them for that very reason, and here they are fighting it out just like Snow and Leavis 40 years earlier (albeit with less class).

Anybody who thinks that there isn't a cultural problem has either not been paying attention or has not been close enough to the metal to see it. We are sure Gates was quite unaware of it in his organisation. We in CIRCUS are aware of it in sometimes mysterious disagreements over apparently innocuous terms which carries additional baggage for one or other of our various groups, but the elucidations are illuminating and sometimes useful. What we still have to do is to understand that while peace may have broken out within our ranks the Wars are still being fought outside them and it is most unwise to think they are over, or even close to it.

3. A Culture With A View - Music Technology

The disciplines defining the foregoing descriptions of culture are fairly new. All of these disciplines seem to have one thing in common, and that is that they are not all the same thing, but more correctly truly interdisciplinary fields, such as music technology, digital cinematics, computer aided design, etc. It is this interdisciplinarity which makes it difficult for a common culture to emerge and jump over the barriers and borders of the more traditional cultures. These fields live in frameworks which are traditionally mono-disciplinary and thus lack the support needed to provide a positive environment for the development of these new areas of creativity.

3.1. The Fourth Generation Dilemma

We can take Music Technology as an example for one of these new interdisciplinary fields and Higher Education as an example of one of these frameworks in which they live. The discipline of Music Technology, if there is such a thing as a "single" discipline of that name, has already acquired a relatively long history, and is thus a good example for investigating how successful its integration has been into existing frameworks. Seeing our students in HE institutions as a part of this history shows how much we, as teachers and learning facilitators, still need to learn in order to teach this new academic discipline within our own institutions.

Our students could be considered the "fourth generation" of music technologists. Oversimplified, the first generation of Music Technologists could be called the "Experimenters" of the 50s and 60s[3]. For the first time a critical mass of technologists and musicians looked at music and technology and tried to develop their own methods of combining aspects of previously different disciplines into one. At the risk of continuing this oversimplification, the second generation of the 70's and 80's built on the basis of the first generation, and with a fast developing commercialisation as well as academic endeavour in this area the speed with which music technology was developed, produced and utilised in works of art accelerated. Centres were created and individuals[4] provided a wide variety of activities within this discipline. The third generation of the 90s and 00s was able to position first lecturers of music technology into academic institutions. Music technology was slowly becoming an academically respectable discipline of education and research[5].For the first time a critical mass of individuals, who had studied more than one discipline and who had a background in more than one field, existed to push this area forward. The fourth generation can be seen to be

[2] Gates feared that shareholders would desert in droves resulting on a potentially disastrous run in share value as soon as its present markets saturated and its earnings growth levelled off. Given that Microsoft had achieved its dominant position through what are now known to be fairly rough tactics it was assumed that Microsoft would have to try to dominate the multimedia market, indeed all markets it entered, in the same way as it had for operating systems and office utilities. Anything less and it was curtains for the share price (most of Gates' fortune was held in Microsoft shares).

[3] with individuals such as Pierre Schaeffer, Karlheinz Stockhausen, Herbert Eimert, John Cage, Robert Moog, Donald Buchla, Max Mathews, Lejaren Hiller, and many more.

[4] like Pierre Boulez , J.C. Risset, Barry Vercoe, Trevor Wishart, Miller Puckett, Gottfried Michael Koenig, John Chowning and Morton Subotnik,

[5] Better-known individuals of this generation such as Roger Dannenberg, Stephen Travis Pope, Todor Tododorov could be named, among many.

our current student body: students of interdisciplinary music technology degrees, such as BMus in Music Technology, or the BEng + Music as taught in the University of Glasgow. These are the first body of students who are studying music technology as one discipline or as one degree.

These degree curricula are of a multidisciplinary nature, but are still given as if they fit seamlessly into our traditional, discipline-based academic structure. Sometimes we, the lecturers, course developers and degree managers, forget that these are degrees which do not have a long standing tradition on which practices can be based, and that we are ourselves are still in the process of learning how to best facilitate the provision of these new degrees and integrate an interdis ciplinary field into a disciplinary framework. This challenge exists on all levels of academic endeavour: from the running of these courses and its administrative frameworks, to the teaching and facilitation of learning, the disciplines' pedagogies and specific vocabularies, and its research with its own particular methodologies.

3.2. Living With The Neighbours

Music Technology is a discipline which is often situated within Music Departments or Music Faculties (and these in turn within Humanities/Arts Faculties). As a result several additional issues present themselves. The practice-based elements of its academic activities might be understood as Music because Music in Britain has traditionally always been a practice based academic discipline, however the methodologies for research into music technology are very different from music, and as such can be very difficult to understand if coming from a point of view used to traditional music research approaches.

Music Technology research methods have always been dosely related to, and adopted from, the science-based disciplines such as engineering and computer science. Characteristics of this research include:

- emphasis on teamwork and collaborative projects,
- emphasis on intense teamwork within creative production projects
- multi-institutional R&D projects
- commercialisation aims and industrial collaboration
- involvement in technology developments with international consequences, such as standards development, basic research, long-term research
- involvement in a wider diversity of funding schemes
- ability to draw on a wider variety of funding bodies
- ability to attract more industry sponsorship
- more opportunities for large scale projects
- more possibilities for industry-bridging activities for universities

These approaches do not necessarily remain only within research areas, but as can be expected and desired, feed back into teaching, utilising teaching methods such as:

- large team projects,
- industry relevant assignments,
- industry placement,
- industry funded/supported projects
- etc.

As a result, difficulties can occur when needing to assess research and teaching within one set of criteria, such as (within the UK) for RAE (Research Assessment Exercise) and QAA (Quality Assurance Assessment).

3.3. The Trojan Horse Complex

What is possibly one of the biggest challenges existing for Music Technology, as for other interdisciplinary new technology based disciplines today, is that of its introduction into affiliated Arts based, mono-disciplinary departments (Music Technology into Music Departments, for instance). This has created a so-called "Trojan Horse complex". The rising interest of music technology has been met by a general decline of financial support for arts-based subjects in the last decade or so, as Governments have followed their disbelief in the Arts' participation in the process of wealth creation to its logical conclusion. This has had the consequence that Music Technology within a Music department is perceived as resource-hungry: a costly but very popular activity - fed by the music industry's need for specialists in this area. This results in a situation in which many Music Departments have had to decrease the size of their total teaching body, but increase the number of staff active in music technology. With the ratio of "music technology staff to musicology staff" rising, intra-departmental long-term strategies might not be able to be formulated without conflicting interests and tensions arising from having to distribute a reducing budget. This is a perfect scenario for Academic jealousies to flourish and internecine warfare to kill the whole thing off[6]. (Does this sound familiar to anyone?)

3.4. Funding The Wide View

Another set of complexities is added to the already existing problems of cultural practices in the differences in funding for different disciplines, and how this influences or challenges interdisciplinary cultural and creative practices. Here we look towards the EU for working funding models for the future, models which will not only support creative processes and tools to support these processes, but which support new and emerging creative cultural practices. Although this seems easy, there are many nuances of differences of funding for different disciplines, which have created a major different behaviour of different disciplines acquiring these funding resources, becoming a barrier to collaborative projects crossing the borders.

[6] Often one or two technology based researchers have more research income than the rest of the department together, thus creating another potential for tensions and adding to the burgeoning "Trojan Horse Complex".

3.5. Maybe There's Another Way of Doing This?

It is recognised that although there is a new funding diversity for multidisciplinary technology based areas of activity, there are many holes in this supporting net of funding schemes and most of these are in the area of the creative arts. Science-oriented funding councils have gradually started to include arts-related development into their remit, if there is a technology based research aspect to the project. Taking music technology as an example, this provides a wide basis for targeting funding and, generally speaking, offers a higher chance of success in acquiring funding for specific projects or parts of specific projects, than in their monocultural parent discipline.

On the other hand this new funding diversity hides the fact that it is fairly easy for funding bodies to duck proposals by using the argument that another funding council is responsible for the researcher's activities. The fact that funding councils do not generally collaborate in their funding calls implies difficulties for researchers who do. It is also difficult for funding councils to accept necessary emphasis on serendipity, and creative and exploratory approaches within the creative arts disciplines as valid fields of research. The generally unhelpful development of having "foolproof project plans" with deliverables spelled out to the detail of PhD thesis, have weakened not only creative arts research but also areas with similar working methodologies, such as basic research[7].

The distortions induced by the application process can be seen as a natural barrier for the masses of interested applicants[8]. It severely disadvantages those who either are affiliated to smaller departments, as most of the creative arts departments are, or those who remain unaffiliated, such as is common among artists. Consequently, most larger interdisciplinary projects have either commercial or science based partners as the central coordinating or initiating instance with artistic presence sidelined or seen as a service to the project. Although it is to be welcomed that the numbers of these interdisciplinary collaborative projects is increasing, we are far from having "creative pull" established in the project structure itself, simply because smaller departments, such as most art-related departments are, do not have the critical size to suffer the burdens of weighty application and project management processes. This does not benefit our (wider) cultural evolution and it is obvious that this issue will need a rethinking of support structures and their requirements in order to provide a more fair funding environment for multidisciplinary activities and to enable the placement of "creative pull" in the centre of technological development.

To minimise distortions induced by the application process, one of the logical objectives for research active groups or individuals is to duck administration and focus on research time[9], i.e. to apply for longer and bigger projects. This is sadly contrasted by the tendency of funding bodies to support a decreasing amount of long-term actions. Three-year R&D projects have become very rare, especially in areas of creativity, culture and education. Projects less than three years have the consequence that PhD students cannot be sought out for these projects and an influx of short-term contract research staff has become the norm. This, consequently, has its own problems, but especially in the arts, where there is not such a steady industry-supported flow of 3-year PhD sponsorships, as in the science and engineering based disciplines.

A common source for such apparent short-termism is industry and the fashion for wanting fundamentally academic projects to be conducted in collaboration with industry. Would-be industrial collaborators complain that they can never see more than 12 months ahead, let alone 3 years. This gets back to funding bodies and horizons shorten. It is an interesting issue to question whether industrial collaboration delivers the sorts of outcomes funding bodies desire. While both of us support the idea of industrial collaboration in principle (it is nice to see one's work being used let alone any rewards that might come out of it) in practice it is as exasperating a process for academics as it is for the industrialists themselves. It is rare in most fields for industrialists to want to collaborate over a specific piece of technology. Companies want to 'own' the technology they develop and one of the most frustrating things about industrial collaboration is seeing the technology which has been developed – usually successfully- being discarded rather than taken up. "Not invented here' is often blamed for this. The whole point of industrial collaborations is that the technology so developed does get taken up by industry but the reality on the ground is that the opposite happens. What industry really wants is access to high-quality graduates whom they may have selected through the collaboration or otherwise.

In fact there is quite another way to develop the sort of technology that industry would want to take up and that is through 'creative pull'. Generally speaking industry is aware of the technology it needs and if it doesn't have it or can't buy it will develop it itself, thus satisfying 'invented here' and 'ownership'. Government grants lower the threshold for the sort of technology a company might think of developing but equally encourages companies to allow themselves to be distracted from their core activities and in the end they decide they didn't want it after all. If relevant technology were to spring ready-formed in front of them from the start then they could take an immediate decision on relevance and buy it if needed but that in turns means the developers being clairvoyant – or being primed via a 'creative pull' project in which the

[7] ..and, it has to be said, much commercial research. Companies often complain that the kind of research they do has to be done quickly and often they can't predict where they'll be more than one year ahead.

[8] This may be the intention

[9] Richard Feynman was famous for this. He always loused up his administrative responsibilities and the word went out 'Feynman is irresponsible' and, after a while, his administrative load dropped away. But only someone with his academic reputation could get away with this.

relevant issues have been highlighted. No act of faith is then required. It is time to re-think the whole basis of industrial collaboration before funding bodies eventually realise they are wasting their money on what are, in the end, culture clashes.

3.6. How To Shape A Culture by Less(?) Stalinist Means – A Case History

Another issue of significance is the support for networking, including conferences, working groups and visiting artist/scientist programs. Few conferences have successfully accomplished a truly interdisciplinary nature with interdisciplinary attendance and interdisciplinary content. Although the interest in these is very high there are again different kinds of barriers to participation[10], and the resultant mix shapes the evolution of community cultures in essentially unpredictable ways[11].

It is interesting to note how the very different sources of, and emphases in, funding for the visual arts and design and those for, say, computer music have shaped developments in the different disciplines. Visual arts seem to have no problem in lining up all manner of funding sources while computer music has been strictly a child of the academic community. Since Universities outside the USA rarely have any money of 'their own' this has resulted in an impoverished, sickly and isolated child. The visual arts seem to have plenty of means for subsidising networking while the computer music community struggles on local charity. This is underlined by the larger number of artists in the visual sector who can be independent and unaffiliated, also by the many conferences in visual media and the sole ICMC conference in Computer Music.

The cultural traditions of computer music (and following it audio/sound design) go back to a time where there was not much money for any arts, thus forming quite early in its history a more science based approach, a more academically slanted approach to computer music. This was where money was available: science based academia. In this community (computer music) the artists have felt, over a much longer time, pressure to affiliate themselves to certain academic or teaching institutions and this has shaped their culture. A casual (causal?) observation is that totally unaffiliated freelance composers seem to be much rarer than unaffiliated freelance designers and media artists.

In reality, artists in the computer music and sound design sector are quite used to going to conferences, and having to set up their installations or performing their pieces without any financial or other support. Only commissioned pieces are supported by registration fees or/and travel. Subsequently conferences which try to include other disciplines within the music technology area, are not too successful in this attempt, as they are normally traditionally run like normal science based conferences with differences in evening events, installations and concerts throughout the day. This format can discourage artists from the visual sector, in which academic culture is less evident than a more general artistic culture, influencing the structure of the conference itself[12].

All this implies that whereas in the communities of media, film and design funding bodies or national cultural bodies are available to support the running of conferences, in computer music it is the universities which have taken up that role and are funding the processes of networking and dissemination. The major difference is in where the financial support comes from as this has shaped artistic cultures and will continue to do so. Although our aim might not be to try to even out these differences[13], these aspects of diversity within the whole creative arts sector should not be ignored but included in future considerations about funding models.

We tamper with cultures when we tamper with funding mechanisms. Beware of what you wish for. The fact that reforms often achieve the opposite of their intention is due to a failure to realise these comparatively subtle linkages. But then, Governments have never been subtle and rarely understand what the levers of power actually do when you pull them, unlike Stalin. Maybe his methods were more transparent.

4. A Model Project

A question we haven't faced is whether we need to worry about cultural mismatches at all. Maybe its quite OK for us to hide away in our monocultural niches and produce wholly technological outcomes without benefit of creative input or vice versa. The result[14] will inevitably be that there are whole classes of problem we cannot tackle at all, let alone the more familiar issue of the rudderless development of technology for creative users which nearly always manage to solve problems creative people aren't really interested in solving. (Hence our interest in 'Creative Pull' as a mechanism for avoiding such essentially wasted activity.) The interesting problems are only exposed by listening and observing.

We can answer the question directly by positing the sorts of project which can only be handled effectively by a collaboration between artists and technologists[15]. It is possible to do lots of hand-waving

[10] One of the most obvious is of course the lack of support for unaffiliated artists to visit conferences. A not so obvious reason is the fact the type, source and amount of funding of, say, visual arts related conferences seems completely different than audio related arts.

[11] We are reminded of the comment that reforms usually produce the exact opposite of what is intended.

[12] A practical demonstration of this is imminent.

[13] Given our comments about the persistence of cultures this may be difficult even if it were desirable

[14] We were going to write 'unfortunately' here but there is nothing unfortunate about it. It is only 'unfortunate' for those who are die-hard stick-in-the-muds.

[15] It could be argued that we could dispense with 'creative pull' within projects with explicitly technological goals on

here in an attempt to avoid looking partisan[16] but the result is bound to be unconvincing. Instead we will show what effect a CIRCUS view point has on our particular lines of work, which mostly involve music although one of us is a Computer Scientist and the other an Engineer who works in Music (so is officially a Musician). Paradoxically the Computer Scientist is most interested in a project which involves interpreting Music and the Musician is most interested in Computer Science issues relating to cultural metadata (databases, information retrieval, networking).

One of our projects involves making a *Fantasia*-style animated film with six pieces of music interspersed with live-action sketches which in effect introduce the next animation[Pat98]. The music is all by one person, the Soviet-era composer Dmitri Shostakovich who, at various stages of his career, had been told by the Communist Party to make his music 'programmatic', so it could be more easily understood by the people. The famous cellist Mstislav Rostropovich is quoted as describing Shostakovich's music as not so much programmatic as telling 'a secret history of Russia', and this is the basis of our film's story. We see historic figures (Stalin, Beria etc.), all caught up in the story the music seems to describe, in such a way that it is likely that their antics would have been recorded by history just the way the record says (if we could figure out what *that* was). The story further endeavours to suggest a hitherto unacknowledged relationship between the pieces of music which have been chosen. One of these is the sequence *the Storming of the Zeelubky Heights* from the appalling Soviet propaganda film, *the Fall of Berlin*. Most of the other music is taken from Shostakovich's Tenth Symphony and indeed the theme of the film is that we are seeing the 'hidden' story in that symphony, which turns out to be a small slice of just such a 'secret history' as Rostropovich had in mind. The strand we are developing here is the relationship between the music of the Tenth symphony and that of *the Fall of Berlin*, or rather Op. 82a, Shostakovich's arrangement of the music from that film. The point is that, as part of developing this relationship we will be staging scenes in the animation to look like scenes from *the Fall of Berlin*, and other contemporary films which might support this idea.

This leads us on to a range of technical issues to do with the realisation of the 'look' and style of the piece. Since these are historical figures and since the film is mostly set in the Kremlin of the early 1950s we have lots of photographic data as to what the principal characters looked like (and how they moved and spoke) and what the set should look like (that is to say not exactly like the Kremlin of the 1990s, either inside or out). There is enough photographic data to construct reasonable facsimiles of the principal characters as computer-generated 3D models and to construct 3D models of the relevant parts of the Kremlin. These can all be rendered to photorealistic accuracy, although this would be both expensive and difficult to do. The argument here is that this would be unnecessary. The story also calls for wholly animated characters with action to take place at cartoon speeds with the exaggerated styles of that form. There is a whole strand of computer graphics devoted to non-photorealistic rendering (NPR or NPAR e.g. [Fek&00]) which starts from the basis of realistic modelling then rendering out using stylised effects. NPR is treated as a wholly technical subject albeit often contributed to by people who come from a more art-based discipline. It is thus a core CIRCUS subject involving both artistic and technical judgements to realise artefacts which employ NPR in their creation.

What the project seeks to develop is a style or look for individual scenes which may include 'traditional' drawn 'flat' animation, posed photorealistic models of the historical characters and 3D backgrounds determined from photogrammetric analysis of multiple views of the modern Kremlin (inside and out). There are a variety of possible solutions but they all have one characteristic in common, no elements should look out of place at any time. The nearest analogy would be with the film *Who Framed Roger Rabbit* where the producers used a cartoon style which suggested the 3D appearance of the characters by rendering out self-shadowing, and blended the photographic elements with the drawn elements by filtering them through an exaggerated yellow filter thus giving them a not wholly naturalistic look. Here we have to do something more complicated because, although we want to convince our audience that they are looking at the actual historical figures on screen, we also want them to behave in styles more consistent with cartoon characters than their real selves would.

The modern way of rendering out cartoon characters, typically depicted with flat colour within regions delimited by sharp black borders, is to filter the black border with a Raised Cosine (or Hanning) filter to 'scallop' the border and prevent it 'ringing' after passing through a DCT codec. This is best dealt with using computer-based rendering, which also facilitates 'pinning' shadows (partly transparent greys shaped to fit over part of the flat fill region) so *Roger Rabbit*-style shadowing (originally seen in the *Dan Dare* cartoons of the 1950s) has also become quite common. The historical characters may be modelled to a photorealistic standard[17], but they can be subject to an analogous process which flattens out 3D shading and generates shadow overlays in the same style. Many post-war Soviet-era photographs have a similar character and there are commercial processes which will produce cartoon-style drawings from photographic data but we want something in between something which is obviously a photograph and something which is obviously a drawing. While there are technological

the grounds that sometimes such projects produce worthwhile products. However the history of technological development for creative users is littered with disasters resulting from the failure to consider creative input, so we don't recommend it. Here we are dealing with projects for which both creative and technological input is truly essential.

[16] David Garcia puts it quite nicely as 'selling our own fish'

[17] again taking photogrammetric data from film footage and fitting conformable models to these

means of achieving the goals stated above, we just don't know at this stage what will look right and this will need an experimental bench on which it is possible to try out options quickly and easily (albeit perhaps impractically inefficient for final rendering). In the end such a bench would need to be both developed and used on the project so its nature would be shaped by its ultimate users, creative artists. This requires an intimate hands-on collaboration between creative artists and technologists, although the outcome may well be a wholly technological product, usable as such by other artists.

The remaining difficulty with 3D characters is that of animating them. A fully photorealistic model has to behave convincingly realistically and, although nobody has yet demonstrated convincing lipsynch with photorealistic human models we don't have to face this particular problem here. We would however have to have our fully photorealistic models behave the way our historical characters appear to on news footage. If we rendered out our characters as fully stylised 'flat' cartoon characters we would lose the link with their realistic origins but could animate them in familiar ways with cartoon effects and timings which would also be consistent with the cartoon characters around them. It turns out that intermediate positions on the scale between fully photoreal and fully stylised allow for the acceptable of intermediate styles of animation, neither wholly real nor wholly stylised. What will determine how real or stylised our representation needs to be is precisely how stylistic our animation needs to be and precisely how far away from the fully stylised end of the scale we can occupy and still 'hold' our audience. This is a process which is wholly technological while the styles of animation are a wholly creative issue.

The third problem area concerns how to render out the backgrounds. Some background elements will be wholly drawn so have that flat 2D look, however mediated. Other elements will be provided from photoaccurate models which can be rendered out with photographic textures or an entire gamut of more stylistic textures which would progressively flatten out the background (although occlusions would be consistent with the 3D model). Having 3D or two-and-a-half D effects in backgrounds gives a more dramatic effect to animation as Disney has been doing with the multiplane camera since the late 1940s, and more recently with computer-generated 3D (but mostly fully stylised) backgrounds since *The Beauty and the Beast* (1990). Once again we have the possibility of generating fully photorealistic backgrounds or run the spectrum from photorealistic to fully stylised. Here the problem is different to the character representation problem because we can make the backgrounds behave like reality. More problematic is the fact that the 1950s Kremlin was not quite the same as the modern Kremlin so some changes to both model and textures will be needed. There is also the problem of capturing all the textures needed, which could be insuperable requiring that missing textures be synthesised. Again it is rarely possible to fill in holes in photographic textures to a quality one can get away with on a cinema screen so it would make sense to cultivate a deliberately synthetic look[18]. Here experience suggests that good photorealistic but fully synthetic backgrounds are quite acceptable with photographed characters in the foreground. However, with foreground elements of varying degrees of stylisation (and similarly constrained animation) it will be an artistic judgement as to where in the spectrum from realistic to stylised the backgrounds should be placed. Here a certain measure of inconsistency is possible (and indeed present in *Roger Rabbit* and *Gladiator*) so it becomes a wholly creative judgement once the necessary technological steps have been taken.

We can thus see that creative and technical issues are intimately intertwined in a context usually perceived as being wholly technological, yet where wholly technically based teams are bound to fail. Some of the technology they have to develop will only be known once the artists have made their judgements and these in turn are only possible because of previous technological developments. This in fact is the first example where progress can only be made by mixed teams.

5. Recommendations

In the end CIRCUS has to report, which means trying to find a coherent set of conclusions, and hopefully to make recommendations to the Commission in respect of the furtherance of the subject of the Working Group.

With such a culturally diverse group there is bound to be a degree of artificiality in any sense of cohesion that the group may want to project. Although we have argued elsewhere that the culture from which we are drawn is indivisible, and that perceptions of distinctiveness are themselves artificial constructs, there are clear subcultures which surface, for example, in respect to teaching. In fact teaching is one of the areas where the WG has focused on quite closely of late, as it is an area where our distinct subcultures can not only help each other but also contribute to each others' methodologies. Making sense of this requires a 'God's View' of what seem like quite distinct positions. Curiously there is a common theme to be pulled out here of practice-based training, which is a characteristic of vocationally-oriented pedagogy and which in turn characterises all our disciplines, creative and technological alike. In academic circles there is a lot of resistance to vocational training despite the fact that it underpins a lot of subjects which are routinely offered at academic level (medicine, accountancy, flavours of engineering, law, music, computer science) and the idea that artefacts can be offered as research outcomes is quite new. We will return to this later.

It is fair to say that it is only at the end of its life that CIRCUS has learned properly what it should have been doing all along. This is not meant as self-

[18] We can extract colour from illumination on the photographic textures and use a synthetic illumination model of known characteristics. This has been done even on 'photographed' films like *Gladiator.*

criticism, rather the lack of definition of the problem area as a consequence of institutional neglect. In essence CIRCUS, like Deep Thought in 'The Hitch-Hiker's Guide To the Galaxy', has had to work out what the question was first and, like the unknown question to whom the answer was famously 42, finding this is the harder task. The important point is that the Commission cannot expect an essentially divergent process (driven by natural divergers) to converge to a single solution (like 42). It is not only questions and answers which have concerned CIRCUS but also, and more pertinently, the processes which lead to them, have had to be understood and built on. This is not something which CIRCUS will have the last word on. There is plenty of scope for a continuing WG tasked with refining the processes within which artists and technologists will collaborate effectively. This requires defining model projects whose outcomes include insights into the workings of these processes and identifying the support mechanisms which would make these projects viable. The fact that this is still perceived as a vacuum was the motivation behind the recent workshop at the IGD Fraunhofer which we have remarked on more than once already, although CIRCUS does have something to say on these topics and does so here, but we know these are not the last words on the subject by any manner of means. There is a lot of learning still to do and lessons still to be understood meantime, these last hopefully appearing as outcomes to the very projects we are talking about here. The Commission needs to consolidate what CIRCUS has started and accept that this will be an on-going process from which cranky noises will occasionally emerge.

One of the main topics such a body would need to look at is that of 'creative pull' itself. This is something that CIRCUS has not itself quite got on top of, mainly because we have no European examples of 'Creative Pull' projects to study. While funding bodies, even – amazingly - within the UK, have welcomed the idea of linking technology to creative development in the style of a practice-led subject, their referees have killed every project which attempted to use the creative pull model. There seems to be no pattern to this assassination, although it is fair to say that both authors of this paper have seen plenty of similar assassination in their own proposals whenever they went anywhere near the subject of 'media'[19]. One suspects prejudice originating in 'sour grapes', but the villain of the piece is far more likely to be internecine warfare between standards of inference in different arms of our supposedly (and generally) unitary culture. It is also a characteristic of whether there is 'enough' funding in the system, which addresses what monocultures think of as their core issues properly, as to whether referees will tolerate adventurous proposals which they may not quite 'get'. It is a characteristic of many of these rejections that the reasoning given, if offered at all, is quite disgraceful. 'Dishonest within the rules of the system' would be a fair phrase to use. The question of standards of inference is one we will be returning to in our conclusions. For whatever reason 'creative pull' is still waiting to be tried and referee prejudice is only one of a number of remaining hurdles we need to get over before we're going to get there, we suspect. When it is tried there will be the inevitable learning curve we cannot anticipate in the absence of actual experience. A new group charged with a CIRCUS-like agenda would need to be there to pick up this experience and shape it for the future.

Outside the problem of referee support, which can be managed, is that of the nature of the funding itself. We have argued already, and shown by example, exactly how an apparently irrelevant factor - the origins and accessibility of funding - can shape a whole culture. Since cultures fossilize quickly and are virtually unshiftable (other than by mass extinctions) once set, the nature of funding mechanisms inevitably fall within our considerations. The substantial point here is that 'creative pull' projects have a creative practice project at their heart and these are usually funded by quite different mechanisms to technology projects. There is thus a measure of double jeopardy here where what is essentially one part of the project is judged according to one set of criteria and the other by quite different ones. While we might argue that this is right and proper the reality of funding processes is that 90% failures are common and at that level the funders are essentially making random decisions about what gets supported and what doesn't. Even if these various parts stand up to scrutiny the arbitrariness of the final selection process virtually guarantees it won't be funded in its entirety and so the entire grand design collapses. 'Creative Pull' projects can only stand a chance of success if they are judged together by referees from both sides working together and making recommendations to a single panel.

Other problems for 'creative pull' include the tendency for IST programmes to have shorter and shorter life cycles in which a creative project will inevitably time out. The reason for this we have discussed already, namely the planning horizons for companies, and the merits for those reasons have been questioned. There is another culture clash here, that between the essentially meritorious desire of funding bodies to ensure their money is properly accounted for and spent on what it was intended for, and that of an IT industry faced with a highly volatile market in which they have to respond in a time short with the approval of funding let alone that of spending it. This is a can of worms well outside CIRCUS's remit but it doesn't mean its outside everybody's remit. There is a great danger that, in ever increasing efforts to be seen to be spending research funds, regarded by many as a luxury of potential sinfulness, wisely, the outcome will be that the money is wasted when it needn't be. We would argue that what is really happening here is that the process itself has not been thought through properly and as a result, in attempting to achieve too many goals at once, manages to achieve none of them. Within the EU the individual prejudices of Governments, who don't understand this research stuff anyway[Patt99], are amplified by the decision-making process into programmes notable for the cynicism of the benefactors acquired through their observations of

[19] This is quite a lot more conservative and traditional than creative pull projects, so is a quite depressing precedent.

previous rounds of funding. This happens at a national level also, for the same reasons.

One could question even more widely and say why science and technology? The more obviously 'cultural' aspects of our society, as well-represented in CIRCUS, address economic needs just as technological ones do. One can argue that the great scientific boondoggles like CERN are ultimately of no greater economic relevance than theology, but in the past scientific research has given us atomic weapons and nuclear submarines and Governments will never forget that. No matter that an Old Master will cost more than the biggest supercomputer at auction, there will be vastly more support for developing ever greater computing power than training artists who may produce the next great art movement. Old Masters are rarely lethal. For all of the Communists' many failings they at least realised the importance of culture in its classical sense (they wanted to control it and manipulate the population thereby) and a composer was regarded with perhaps greater reverence than an academician. (This may have been part of Russian culture long before the Communists.) There is an old tradition in Russia of restraining artists. Perhaps for them an Old Master could have deadly implications, something which has been forgotten in less repressive Europe. The reason for such a contrast between dollars earned from science and dollars earned from selling paintings lies, we suppose, in the different models of economic exploitation. The economics of much creative work is driven by the mechanism of 'the best drives out the rest', which is the driving force behind the Hollywood Model[Mick&96]. There is really only room for the 'stars' to flourish, but that doesn't mean there isn't a need for mechanisms to find them out. Too often it is left to chance, but incumbents have a vested interest in discouraging challengers too. Science, at least, is a process in which individual motivations tend to cancel out, which is probably the origin of the economic attention paid to it.

What the EU might want to do about culture is another matter. There isn't a 'European' culture as such (unless you're an American whose ancestors escaped one form of long-gone oppression or another), and not doing anything about one's 'own' culture is an invitation for someone else's culture to come and take over, and there is an obvious candidate here[20] (over a good few Dead Bodies, we expect). Culture isn't stuff which can really be thought about in economic terms and the consequences of a cultural take-over are pretty devastating from the few times its happened. The EU may well want to resist such a thing and there are no doubt quite a few nationalities who would go along with that, given most European nationalities have quite ancient cultures, many of which are in retreat before the invader. But how? What kind of programmes could encourage the expression of a culture? Clearly, from previous examples, funding and funding mechanisms are crucial even though their effects may be unpredictable. There is a strong case for 'Creative Pull' playing a key role here. It is a concept of huge power if applied seriously in the context of developing an indigenous culture. Is there a will to do it? If culture goes on the agenda with a comparable remit to, say, IST then there needs to be serious thought given to what one is hoping to achieve and how its all going to be managed. This is and always has been well outside CIRCUS's agenda, but again it has to be someone's.

From here on our recommendations tend to slide off into the nitty-gritty and away from the broad-brush stuff. One of CIRCUS's early considerations was over Vertical Markets when a concern from André-Marc Delocque Fourcaud (CNBDI) happened to coincide with the publication of a book [Wolf99] on how the Film Industry managed to take advantage of vertical marketing to offload the risk of film projects. The point was that strip cartoons in Japan, typically *Mangwa*, manage to generate vertical markets by leading on to films (e.g. *Akira*) and all the vertical marketing that follows from a film project. This is a phenomenon that we are now beginning to see in connection with computer games, and it is not surprising that Japanese games (*Super Mario Brothers*, *Mortal Kombat*, *Final Fantasy*) are leading the way here. André-Marc's argument was that if this could be done in Japan, why not in Europe where a similar strip cartoon culture exists? The answer to the specific question is almost certainly a matter of culture[21], but this did lead us into a consideration of vertical markets generally, how they were formed, what support mechanisms there were behind them, in short the sector advantage issues which lead them to form in some regions and not others [Pat01].

While it is fairly obvious that sector advantage has caused an over-concentration of support mechanisms for film industry vertical markets on the West Coast of the USA and their consequent failure to establish themselves anywhere else, it was also apparent that the whole idea of vertical markets in this sector had only grown up in recent years. Further, the advent of digital technology[Bro00] as a burgeoning viable alternative to the medium of plastic film[22] opens up the possibility of one of those seismic shifts in the industry which can be exploited by canny outsiders. With the shift could come a shift in the economics of the sector advantage available on the West Coast. Three mechanisms were advocated, extension of the cross-media ownership laws to prevent distributors monopolising exhibitors (cinema chains) as well, extension of the tax break regime allowable on film projects to related vertical market products, and the development of national film schools into research and training centres for all levels of the vertical market.

[20] As Jay Leno said 'We're going to ruin *your* culture, just like we ruined our own".

[21] although there is a European example in the form of Vadim's 1968 film *Barbarella* but here we expect that different contemporary cultural attitudes inhibited the formation of a vertical market around this particular film project. While true the Web says 'not in 2001'. Try http://www.multimania.com/angel/Barbarella/

[22] Celluloid film has that unique and irreplaceable inflammatory quality so sought after for Molotov cocktails

What was more interesting was the sort of entity which could be considered to be a vertical market element. Already known to be part of the vertical market were such things as documentaries 'The making of..', 'The story behind..', the film music, the book of the film, franchises, toys, games, Tee shirts, etc. In essence ''The making of..' and the book of the film were themselves the basis of training materials which could be studied in film schools, art schools and media courses. Now programme commissioners are beginning to insist that new projects have some kind of Web presence, essentially advance publicity, and that they would have ownership of it as part of the rights package. However ''The making of..' is essentially a taster for a film product which itself now needs to have a taster (on the web), but its web presence could be far more substantial and could become a training or reinforcement element in its own right, a superset of its broadcast form rather than a subset. In some cases the same is true of the film itself, if this contains topics of any academic merit (e.g. history, geography, biography). Where technology is involved "the making of..' could extend to the technological means used and their scientific and mathematical origins. The extent to which one could back-reference through knowledge and culture is significant even for the most unlikely film projects. A good example of this is the ever increasing number of *Star Trek* franchises, where not only are the most advanced technological means used to generate the imagery, but the bogus science could be analysed and its relationship to genuine scientific knowledge[23] elaborated[Krau98]. Film projects could make a powerful contribution to our knowledge base and teaching aids, but while many have speculated that the film majors could come to dominate academic teaching by such means there is virtually no evidence of any moves in that direction.

Another CIRCUS concern which unpacked from this strand was models of academic teaching. This has resulted in some interesting exchanges due to the very different pedagogical traditions of practice based disciplines (art and art schools), disciplines with a significant practical element to support understanding (music, and yes! - computer science) and those with a more purely theoretical element (e.g. mathematics, where students do exercises solely to determine whether they understand the theory). Even music and computer science with similar practice-based requirements have quite different pedagogies because of their different subcultures, although computer music interestingly short circuits the entire 'creative pull' argument by developing creative and technological concepts within the same discipline, something familiar to artists up to the point when their tools started to include computers. Computer Graphics, a subject which usually has its home in University Computer Science or Engineering departments makes a fairly sharp distinction between systems construction and image creation, again for reasons of how the culture developed (i.e. quite unlike computer music). Typically Computer Graphics has to struggle with other Computer Science sub-disciplines for curriculum time and for a long time has been regarded as a difficult dilletanté subject of little applicability, so marginalised. The practice of using computers to make artistic images is carried out in schools of art by people of an art and design background using software packages. It is here that 'creative pull' has to bridge the widest gap, and is most needed. It is also here that the different pedagogical traditions are furthest apart, so lessons from one side of the discipline for the other are hard to extract. If we are going to make progress here the most obvious way is to take a multidisciplinary approach and refine the lessons in the light of experience. For technologically-based reinforcement aids this could be an advantageous approach, saving development costs and resources. It could still fail if the pedagogical gap is too wide, but we won't find out until we try. On the other hand fishing around in other peoples' disciplines is an exciting experience for those positively motivated to do it. To the despair of generations of teachers students don't seem to have any enthusiasm for anything but grades, but maybe this approach will bring back the enthusiasm we all try to catch but so rarely find.

Another CIRCUS concern prompted by this is in the economics of technologically-based remedial aids. This is another example of ''the best driving out the rest' economics[Pat99], with the promise of riches for the (few) academic superstars and the most unrewarding part of the academic experience for those obliged to follow in their wake (nearly everyone else). Such polarisation would also defeat the traditional position in scholarship which assumes individual prejudices cancel out if there are enough individuals contributing. The solution is seen to be in the equivalent of the 'Open Source' movement in software[Econ01], currently the subject of attack by its sworn enemy, Microsoft. We have been striving to see how the Open Source movement can offer financial incentives to its participants while encouraging wide participation thus defeating polarisation. If we can understand that model then it should be possible to transfer it straight across to telematics-based learning, although it is also argued that this is a medium we don't understand well enough to use as yet. This hasn't stopped plenty of people trying, with the outcome that there is now a consensus of opinion that our present understanding of what these models should look like don't work. Our view is that the absence of evidence is not evidence of absence and that maybe some rather more imaginative thinking, certainly plenty more R & D and demonstrators, are all required. Again culture seems to be the main inhibitor of thinking out of the box. After all we are trying to replace centuries of pedagogical experience with ignorance.

One important feature of Open Source is that it encourages de-facto standards and the IT industry is always keen on standards. They save money overall and encourage competition, also if its your standard

[23] Unfortunately people seem to prefer the bogus to reality. The *National Enquirer* in the USA is a best-selling newspaper famous for its promotion of bogus knowledge, while its counterpart, *The Skeptical Enquirer*, set up by genuine scientists anxious to expose the bogus in the *National Enquirer* for what it is, struggles along at the price and subscription levels of a scientific journal. Far more people follow astrology than astronomy, and at least 10 times more people practising astrology than there are astronomers.

you can become very rich and dictate how the market develops. CIRCUS has made contributions on the individual level to the MPEG 7 standards debate, seen to be critical to the creative industries. This experience, however demonstrates the lack of creative/cultural user representation within standards development bodies. One sector which has not been supported in any obvious way within programmes like IST is that of contributions to standards. The point here is the will to do it rather than the mechanics, although simply providing funds to support working on standards bodies would seem an obvious way to go. The kids of contribution one has to make to standards bodies also depends on such things as the externalisation and structure of implicit knowledge which has to be elicited presumably through targeted projects intended as precursors to demonstrator programmes for standards bodies. There seems to be no provision for workplans derived from the agendas of standards bodies in this way. It's a black hole.

Finally, it is fair to say that the specific goals of CIRCUS in respect of content, medium and technology, and the ways in which these were refined in the original proposal have not been promoted in IST projects mainly because there seemed few, if any, work programmes in which they could flourish. More usually the topic had to be smuggled in by the back door into some project which seemed to address a quite different agenda. We would include in this the development of experimental interactive creative environments in their own right rather than for their social goals and something which has been the subject of considerable misunderstanding within CIRCUS (apparently because of a culture clash), namely the whole issue of styles as a means of understanding the strengths (manuals of good practice) and limitations (techniques for mitigating inherent constraints) of new media. One could argue[Yu98] that a well-known 'hard' technological problem of common interest, the automatic in-betweening of cartoon drawings for animation, can be solved by such means, and there may well be others. We are reminded of the story about Charles Babbage who, by all accounts was an irascible gent, and hated organ grinders (a common feature of the London streets of the early 1800s). He was wont to chase them down the street if they disturbed him thinking out his designs for new computation engines. One of his particular problems was how to control the computation. If he had but thought that whoever had supplied the organ grinder with his instrument had solved an equivalent problem long previously (remember the analogy between music and computer programmes) then the history of computation might have been very different. All he needed to have done was to invite the fellow into his house and had a peek into the box to which the grinder's handle was attached. If he'd had the sense to do that he'd have also realised how to solve his problem[24].

[24] A science fiction story written by William Gibson and Bruce Sterling 'The Difference Engine' starts with this premise.

6. Who needs whom more? (conclusion)

It should be borne in mind that this is a somewhat one-sided view of CIRCUS so much of the cut-and-thrust of what we've discussed is under-represented. We believe, however, that we've captured the essence of what CIRCUS has been trying to do and much of where we think we are and can conclude from our work. Our real discovery was that the CIRCUS agenda was far larger than we imagined , so its full realisation could be fare for many children to come. If, indeed, we accept that we need to address cultural issues as eagerly as technological ones, and be able to improve our economy thereby, then the 'creative pull' model we have talked about so much could be the main engine by which such engagement could be made. Most particularly for 'creative pull' to work, it is essential that cultural artefacts be permitted to be at least the partial embodiment of the outcomes of projects which use it. Such a development would be by no means novel. The concept of the practice-led PhD[Pat&01] and the next round of the UK's Research Assessment Exercise (RAE) both allow for artefacts to be involved in the assessment process. Were the EU to adopt this[25] with 'Creative Pull' it would just be in line with other developments which have preceded it at national and international levels.

Of course the whole CIRCUS idea could be dropped from future EU agendas but if that's done, as we've shown here, the not only does that put legitimate lines of enquiry beyond reach but puts in jeopardy possible lines of defence against the sort of Cargo Cult culture waiting in the wings to exploit any weakening of the sense of identity that an independent culture engenders. Something like this seem to be happening in Japan, with its bizarre imitations of US icons which somehow completely manage to miss the point, or maybe it's the sameness on top of something completely different that is the point. Either way, it's a warning.

There is one final closing point, and its to do with the question of whether the culture wars of the 50s are relevant to-day, and also the question of (culturally) different models of discourse. In 1996 a Professor of Physics, Alan Sokal, published a now notorious spoof paper 'Transgressing the boundaries: Towards a transformative hermeneutics of quantum gravity' which was accepted in all seriousness in the refereed American cultural studies journal *Social Text*. It was not just any old edition of *Social Text* but a special edition devoted to rebutting the criticisms levelled against postmodernism by several distinguished scientists. After publication Sokal immediately revealed the hoax and thereby precipitated a 'firestorm of criticism[26]' in both the popular and academic press. Much has been made of the success of this hoax but Sokal himself[Sok&98] takes the view that his goals were quite modest in that he wanted to expose the abuses of scientific concepts by the same people who

[25] This may be changing even as you read this

[26] Our favourites are *Figaro*: "C'est la Guerre", and Magiori in *Libération* "Humourless scientistic pedants who correct grammatical errors in love letters"

were attacking the whole scientific programme altogther, the so-called 'anti-science' movement. Essentially he was saying that this particular Imp erium was underdressed.

Why are we highlighting this particular event (apart from our suspicions that the odd whiff of postmodernism has crossed the debating table from time to time)? Sokal [Sok&98] himself refers to 'the two cultures' in his analysis of what he thinks has gone wrong, namely the worsening of the tensions which have always existed between them which is progressively undermining the conditions for a fruitful dialogue between the humanities and social sciences on the one hand, and the natural sciences on the other. The particular point he makes concerns the different cultures underlying the conventions of inference in the different disciplines. Sokal points to the use of words. In science sometimes ordinary-seeming words are given precise definitions which capture the essence of the context in which they are used but do not necessarily capture all the cultural baggage heaped on their homonymics over centuries of more prosaic use. It seems that in philosophy the authority of the user of words is significant in the pattern of inference, and that scientific terms, which carry their own authority but only in context, can be plundered at will if the reputation of the user lets them get away with it. Sokal tells a story to illustrate the point:

> We met in Paris a student who, after having brilliantly finished his undergraduate studies in physics, began reading philosophy and in particular Deluze. He was trying to tackle *Difference and Repetition*. Having read the mathematical excerpts examined here [Sok&98], he admitted he couldn't see what Deluze was driving at. Nevertheless, Deluze's reputation for profundity was so strong that he hesitated to draw the natural conclusion: that if someone like himself, who had studied calculus for several years, was unable to understand these texts, allegedly about calculus, it was probably because they didn't make much sense. It seemed to us that this example should have encouraged the student to analyse more critically the rest of Deluze's writings.

Anyone who still thinks that there isn't a problem between 'the two cultures' has definitely not been paying attention.

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Using the Web as a Pedagogical Tool

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0.Abstract

This paper summarises the case for one particular model of teaching reinforcement, a process considered normal in US Universities but largely left to students in the UK system. The first argument presented is that the student cohort now going through the UK system is more like a traditional US mix than a traditional UK mix yet UK Universities have not woken up to this. The second argument presented is that if teaching reinforcement is mediated by electronic means, e.g. via the Web, then this represents a commoditisation of knowledge and *de facto* creates a market in which such commodities are traded. The third argument is that the convenience of commoditised knowledge will create its own demand, particularly in the present state of the market, and enforce the economics of 'the best drives out the rest' in a very similar way that happens in film and does not in the theatre. The size of the market and 'best drives out the rest' economics will cause a damaging polarisation of scholarship if thought isn't put in at the beginning as to how to avoid this. It is argued that existing attempts at doing this will prove ineffective but potentially effective solutions have not yet been attempted.

This all assumes that such a commoditisation is feasible, something which is increasingly doubted by commentators. The argument given here is that it is feasible and the technical and presentational issues surrounding it are elaborated. We then show that there are no exemplars of the approach(es) we are advocating. Instead, a number of research issues involving technology, pedagogy and production values are identified as requiring answers before the feasibility issue can be resolved either way. We believe feasibility will be established but we need exemplars to prove the point.

Not discussed here are the economic or business case for such a commodity market. This is discussed in other papers[Pat99] [Pat01.2]. On the back of feasibility comes inevitability but this will be served neither by the rush to implementation in the present state of ignorance, nor by dangerous denials of the reality of the problem, for which the UK is uniquely-ill equipped to face up to.

1. Introduction

This paper aims to expand on the idea that we are all going to have to face a radical shift in our teaching models to accommodate the 'new model' student. This hypothetical being is not like his elitist cousin and has three characteristics which need to be thought about. The first is that he comes in far bigger cohorts than before (at least in some subjects). The second is that his abilities are much more varied than before, with an average ability which is well below that of his elitist forebear. The third is that he will present himself without necessarily having specialist skills which we have always taken for granted, like being comfortable about manipulating algebraic formulae, or an ability to read music scores. Some new model students will be indistinguishable from the old, indeed in some subjects the best are even better than before, but the majority will be quite different, and marked by what we might regard as poor motivation, an inability to remember lots of things at the same time, and increasingly short attention spans.

Rather than taking the obvious view that our culture is going down the tubes it is important that we face up to the challenges of this new model. There are really only two choices, either the student changes or the system changes. Whether it is even possible to change the student model by means other than going back to the elitist days where only a tiny proportion of the school leaving age cohort ever went to university, this paper does not discuss. Instead I am floating the idea that it is the system which has to change, not the student. I believe the solution lies somewhere in the vicinity of the slogan 'making science [much] more interesting', 'making knowledge accessible to far more people', and 'the commoditisation of knowledge'. These are also goals most people (with the possible exception of Paul Johnson[1983]) would consider desirable for one reason or another.

These are, however, goals whose feasibility many people have cast doubts on, mainly for reasons of being unable to find good, even any, exemplars for them. The argument which will be made here is that people have been looking in the wrong places mainly because historical attitudes to education have pointed them in the wrong direction. Empirical psychology has demonstrated that individuals have different modes of thought and this has been demonstrated in intelligence tests for decades[e.g. Eye66], yet most teaching is still done using just one

mode, that of verbal or linear progression, which is favoured by no more than 25% of the population[1]. It is unsurprising that in societies where all modes are otherwise widely stimulated that there is increasing resistance to classical models of education[2] from public and state alike. This, unfortunately, is colliding with the realisation that the so-called knowledge industries are the key to future prosperity, both national and personal.

The issue has become urgent because practitioners, recognising the economic forces which come to bear here[Pat99], are putting their mostly half-baked ideas into practice more out of fear and a sense of necessity than a fully thought-through strategy. The future of education now lies between the empires of 'the best drives out the rest' school[Econ97] and the wasteland of yet more ruined dreams[Econ01.1]. If either of these scenarios plays out there will be no scope for trying to build an education model based on capturing peoples' interest, whether in formal education or in a life-long learning agenda.

This paper is structured in two parts. The first part (section 2) lays out the various arguments which have been offered both for and against the new models of pedagogy. This ends in a review of hints (section 3) that there may be different and unconsidered ways of drawing lessons, ways which have lain unconsidered because centuries of traditional pedagogy have had little choice in the matter and attitudes have fossilised. We then discuss practical means (section 4) by which new modes may be implemented, although these are also bound up in arguments about ends. Unfortunately it turns out that the most powerful tool in the armoury, that of self-modifying presentation, is also potentially the most dangerous and we are inevitably drawn into issues which seem quite unrelated to the main goals (conclusions, section 5). There are also questions for education theory at the end which demonstrate that there is still quite a lot of research to be done, which is borne out by the conflicting views we had to wade through at the beginning, and it would be unwise to rush to implementation just yet, whatever the intensity of the economic forces.

2. Received 'Wisdom'

The argument showing the inevitability of new models of teaching involving telematics-based reinforcement (ultimately e-learning with no direct human contact) has been rehearsed in many places [Econ97][Econ01.1][Pat99]. In some cases it has been recognised that the same economic forces driving the education system towards such models will also create an elite of academic superstars whose courses dominate[3] their market sectors. The logic is that of 'the best will drive out the rest' economics, which applies in such contexts as film actors and motor racing drivers. In this model small advantages become exaggerated with the rewards being concentrated in the hands of the few with the small advantages over the rest. The danger, in education, is twofold, first that scholarly authority will be concentrated in too few hands, and the second that everyone else in the academic World will be excluded from contributing to scholarship except at the least rewarding, and lowest valued, end of the range of teaching activities. Not only is such concentration dangerous socially but it is inimical to the progress of scholarship. Individual scholars are motivated in all manner of ways but when their work is aggregated these individual motivations tend to cancel each other out. This is an effect which is only really true if the pool of contributing scholars is large enough.

Recognising this, the Massachusetts Institute of Technology, in a highly publicised move, has recently decided to make all their teaching materials available without charge on-line. In their press announcement the motivation in doing this, namely to finesse attempts at polarising scholarship, was made clear. While worthy in principle the MIT initiative is highly unlikely to achieve this aim[4]. It is equally clear the institution intends only to make its regular teaching materials, effectively lecture notes and tutorial guides, available on the Web. This is essentially the same mistake academics always make when considering the Web as a dissemination device. Reading off a computer screen is considerably more tiring and less convenient than reading paper, so all the Web is doing here is to provide a convenient distribution mechanism for material much of whose nature is constrained and possibly even distorted by being forced into the read form. While the Web is quite capable of carrying any mode of presentation, departing from the read form involves a huge escalation of costs which even the mighty MIT could not sustain without some assurance of return on investment. Essentially the MIT initiative is itself at

[1] Hence the success of television over radio; 50% of the population prefer the visuo-spatial mode.

[2] This is coincidentally exacerbated by the unwillingness of governments to resource a system which they feel increasingly uneasy about, sometimes for ideological reasons, sometimes for practical ones, and sometimes out of sheer incompetence and prejudice. The dangerous claim, made more than a few times from official circles [in the UK, un-named Civil Servants], is that education is only for the elite few who can take it, and for the rest its about teaching them their place in society.

[3] Domination in marketing terms usually refers to taking more than 78% of the entire market[Lew96]

[4] If it were successful it would destroy the market in commoditised knowledge 'at a stroke'.

risk of being finessed, a salami slice at a time, by high production value products which commoditise specific strands of knowledge exploiting the most effective modes of presentation, particularly those which are not primarily of the read form.

This assumes that it is indeed possible to present topics on the Web more effectively than in book and note form, although this has been questioned because of a lack of exemplars [Econ01.1][Cai01].The argument which will be made here is that it is, indeed, possible to make use of the Web as a reinforcement tool which can, where it has to, substitute for direct contact altogether, and which is far more effective a teaching method than those essentially using the read form, and its linear variants, alone. Frances Cairncross [2001] in an article seemingly critical of the use of the Web as a teaching aid is actually being critical of it being used *by itself* as a teaching method. While what we say here suggests that even this view is mistaken, because of a lack of convincing examples, there is plenty of evidence suggesting that the use of telematics-based methods as a reinforcement tool, or otherwise in conjunction with face-to-face teaching, is more effective than the read form or its face-to-face equivalents alone[Hall00]. The substantial point here is that we are not arguing for a model in which telematics-based methods are used alone, and in fact there are serious dangers in trying to do this, but where face-to-face methods and telematics-based methods are used together. The teaching model has to be extended, not superseded. However the element which extends it could be far more effective than anyone has imagined up till now.

3. Motivation

What we are going to do now can be thought of being like throwing stones down a well. We can't really see what's down there but the sounds that come up tell us something about what it's like. The conclusion will be that some really radical thinking could result in a wholly new and far more effective style of pedagogy than we have seen so far.

Here's the first stone. People have speculated that companies like Disney[Econ97] are going to dominate the commoditised teaching market from examples like *Donald Duck in Mathemagic Land*, *Man in Space*, and even the two *Fantasias*[5]. In fact Disney has been quite minimalist in its exploitation of the potentially huge assets it has locked up in these (and no doubt other) productions which could be used most effectively. This is a quite general criticism of Hollywood [Pat01.2][Krau98][Krau01] and it would seem that Hollywood has no interest in attempting to develop purpose-built educational materials containing their hallmark stunning production values, and little interest in the sector altogether[6]. This could be because they have only part of the puzzle, but works like the foregoing are suggestive of the potential.

Films are not the only entities which have attracted individuals to take up, say, science. The *Dan Dare* strip cartoon[Morr&98] and the centre-page cut-away diagrams of often fantastic engineering projects have been referenced by many[7] as inspiring them to take up a scientific or engineering discipline. George Gamow's Mr Tompkins books [Gam&99] are similarly credited with stimulating interest in Physics. All of these works have a similar idea behind them, that of developing technical ideas through an appealing narrative. It could even be argued that the bogus science of *Star Trek* could be used as a springboard to an interest in genuine scientific ideas, as Larry Krause[1999] has attempted to do [Krau01]. My own experience here is in respect of my use of an episode of *Star Trek: Deep Space 9*, which combined footage of the 1960s TV series with the 1990s series, as a demonstrator of digital composition techniques, and problems associated with its use. Most students rated this element of the course very highly while a few were hostile to it, mainly because they didn't understand the point at the time, or didn't like *Star Trek*, or both. This underlines the first problem that might attend such an approach, namely that a presentation which wasn't neutral in respect of values outside its specific domain of applicability might actually decrease its appeal for certain individuals rather then increase it. This is a far more serious issue here than in a classical teaching situation because it may well be impossible to remove the offending bias in something that was already commoditised.

The assumption a reader might make is that we are aiming to capture interest through telling stories which by themselves make a lesson. While this may work with young children, it swiftly becomes a very inefficient way to teach courses at later levels, say well before secondary level. There may well be scope for the narrative

[5] When *Fantasia 2000* came out Disney devoted a website to providing course notes for teachers to make lessons out of the various sequences. Somewhat dubiously *Fantasia* is described(not by Disney!) as one of the really great films to watch while bombed.

[6] Disney does have a presence here but it does not even bother to reference any of the foregoing titles in this context, with a slight exception of fantasia 2000, as mentioned.

[7] Including Stephen Hawking, many of my immediate colleagues and myself

approach, for example teaching sciences through their historical development but, again, you are exposing students to a lot more than they need to understand a subject. The converse of this is that it is regrettable how many students go through intensive science courses with little knowledge of the history of their subject. They might even be taught by one of the pioneers of their subject, yet show little regard for this [8], not understanding the significance of the experience. What is most likely to work is the development of non-major subjects from an historical perspective coupled to the option of studying the history of the major subject together with the independent development of contemporary arguments. This suggests another element in such a model, namely that the student should be able to affect the presentation by means other than conscious navigation, i.e. by more than following hyperlinks or using search engines (which pose serious problems of orientation and coverage management). Sometimes a student may need to approach a topic by following the historical motivations, so is offered the material in this mode, but sometimes it will be un-necessary to do so, so is given the option of taking it in this mode while the material is offered in a more directly didactic mode. The question here is, how is this choice made? The student is not necessarily the right judge so the choice of preferential mode of presentation has to be made by other means. This is the beginning of an answer to the question of handling non-neutral presentation modes.

The last stone down the well is the example of a single book, *Gödel Escher Bach: An Eternal Golden Braid* [Hofs00]. This has been described as one of the great unread books of the late 20th century (presumably joining Hawking's *A Brief History of Time* in that respect). Hofstader manages to mix most of the elements we have discussed here together, using often hilarious parables[9] to develop key ideas and then demonstrating how they are re-expressed in different ways the arts and sciences. The Web demonstrates how many people have been inspired by this book and its eclectic collection of themes across the range of classical western culture. Courses have been given, (e.g. [Mol96]) with the express intention of providing a guide to the book, typically pulling out the core themes (mathematics, art, music) and using the book's model to develop them fully. There is much in *Gödel Escher Bach* to inspire a model of a course structure containing culturally rich multiple strands in a multi-faceted approach to sometimes difficult subjects. *Gödel Escher Bach*, for those who have actually read it, seems to have reduced the height of the intellectual hurdles by offering alternative viewpoints in a stimulating and entertaining way.

The Web can be like a book, a film, or even the radio. It can mix its models and literally copy all the things we have here. However, it is the mix of ideas which is important, and that of being able to choose a preferred mode to receive each expression of those ideas. The Web offers that too, but it also offers more, and we will need to exploit all the capabilities of the Web if we are going to manage to draw all these disparate themes together. The late Douglas Adams remarked on more than one occasion that the way people use new media at first is by using the conventions of the old. Here we have the opportunity afforded by combining modes to develop new styles and conventions. Unfortunately the dominant mode for academic material is still that of the oldest medium of all, and we have to break out from that.

4. Implementation

So what would one of these 'teaching' web sites be like? So far we have concentrated on issues related to production values, which is the main theme of this paper. Now we have to look at the context in which this tool would operate. Although this has implications for the future commercialisation of this tool, and by implication the justification for the inevitably high costs, we will not discuss these here.

A key issue which has stimulated the thinking which has led to this paper and its companions [Pat99] [Pat01.1] [Pat01.2], is that of the shift in the nature of the student cohort at UK Universities. Up until the past 20 years or so the British university system was seen as an essentially elitist system catering for those who were self-motivated enough to learn. The quality of outputs in international terms justified the high costs of teaching, although so little effort went in to cost-benefit analysis that it wasn't clear where 'teaching' stopped and 'research' began. The principle was just that laid down by von Humboldt in 1800[Econ97], of the synergies between teaching and research which in recent years have come increasingly into question[10]. In fact the origins

[8] this goes beyond the healthy disregard of authority that students traditionally have shown to their mentors

[9] like the one about the art of making recordings which destroy record players – this is from the days of Vinyl –by putting record-player destroying sympathetic vibrations in the recording; this neatly introduces the concept of Cantorian diagonalisation and its implication for the Gödel incompleteness theorem.

[10] In my view this questioning has arisen not because the principle is wrong – it has worked before and there is no reason why, if the correct conditions are re-established, it could not work again – but because

of this questioning really lie in changing perceptions of the role of Universities in society and in the change – the great increase – in the need for technically qualified graduates to support the commercial aspirations of advanced Western economies. The state needs graduates in far greater numbers than the system of 20 years ago was going to provide and an independently-minded University system did not like the look of the compromises it would have to make in order to satisfy that need.

The outcome has been that Universities have been coerced on a carrot-and-stick model into taking on, over a short time-scale, significantly more students than their resources were ever designed for, many with a dependency culture nurtured in a school system distorted by trying to optimise the positions of individual schools in crude league tables. University participation rates in the school leaving cohort have jumped from figures of the order of 10% to of the order of 30-40% and, apart from per-student capitation, no provision or concession whatsoever seems to have been made to the full consequences of this fundamental change. Moreover the economic forces on this student cohort are very different to those of 20 or even 10 years ago, and the stresses on students trying to finance themselves through a University system which historically has only needed to offer minimal help to a few, are evident to anyone who has any association with the system. The USA has never had a systematic support system for students but for, we hope, different reasons[11] has similar participation rates among the school-leaving cohort. The US system also has long established *ad-hoc* support mechanisms for students to 'work their passage' in ways which don't conflict with the timetabling of their studies. In the absence of most of these support mechanisms, and little likelihood of their being put into place any time soon, UK universities are seeing pressures to distort timetables (repeating the same courses endlessly, including during unsocial hours) coming from students individually making historically high demands on staff time because their dependency culture can't cope in a system designed for a self-motivated elite.

The distortions going on the UK university system are properly a subject for some other work. Here we are concerned with just one aspect of this, and this is the teaching model, now directed at a cohort which is singularly unprepared for it. The reality is that the students are not going to change, in fact their developing dependency culture is becoming entrenched, so the only place where any relief might be possible is in the system itself. Briefly, the system is going to have to go over to a US-style 'reinforcement' model and in doing so could relieve most, if not all, of the pressures which are distorting the provision of higher education in the UK to-day.

What happens in the USA, even at leading schools like Stanford[Pat99] and Caltech[Fey97], is that students have systematic means for reviewing their taught material. At Stanford a system for reviewing videotaped lectures on demand was put in and proved successful even though the quality of the video feed was often not up to holding 100% of the information being passed on, and at Caltech they had a system in which starry lecturers were wheeled on to give set-piece lectures, and reinforcement then carried on in groups of about 20 immediately after the lecture. In the Caltech system students were simply not allowed to walk away from the place the lecture was given without being given every chance to understand what the lecture was about and every opportunity to talk out difficulties of comprehension. In the Stanford system students liked to be able to review the lecture at their own speed, stopping, rewinding and repeating sections at need while building up their own annotations. Elements addressing all of the problems we have identified so far can be seen in these two systems.

The specific assumption is that we will use the Web, with all the advantages this provides in respect of support for multiple media and modes as well as capacity. There are severe practical disadvantages in using to-day's web which we will assume we can overcome by unspecified means although in practice we believe that the only effective way of doing this will be through providing resources sufficient to the need. If we can provide convincing exemplars the motivation to do this will be there. For example although the technical means of the Stanford lecture-on-demand system is not explained it would in all probability be a near video-on-demand service over purpose-built broadband. To-day such a resource could be used for all Web traffic.

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the whole system has been so grossly abused by successive governments that the machinery is breaking down.

[11] The US BS (4 years) + MS (2 years) degrees take a graduate to about the same level as a UK BSc (3 or 4 years) . The best US Universities would take the student perhaps one year further on, the equivalent of a 1-year MSc, which is rarely done in the UK. The US BS degree in effect restores the focus lost in the wide but shallow secondary education system. The US schooling system is very different to that in the UK, performs amazingly badly on international comparisons, and is riven with at least as many problems as in the UK. The hope is that the UK doesn't plan to make its education system even more like that of the USA, because their remedial system, the Tertiary sector is funded in ways the UK could not match, so imitation would result in our inheriting the worst of both systems and none of the best.

The teaching model is that of providing a web-based resource as a reinforcement tool. This resource is not intended to replace formal teaching but to supplement it, so many of the web resources (video etc) could be used in set-piece presentation. However, it is inevitable that some, maybe many, students will be forced to use it as their primary source of initial exposure, so acceptability is a key issue. Although minimally intrusive on traditional teaching models, preparation of such a resource is fraught with difficulty and expense, but we will confine ourselves here to delimiting the sources of these costs. In fact there are three issues which set the lower limits of cost and complexity, namely technology, pedagogy, and production values, but in the end it will be seen that ignorance rather than expense (even though that can be severe) is the greater constraint. 'Technology' here addresses issues of modes of presentation, methods of search and choice. 'Pedagogy' addresses mostly unanswered questions about effectiveness, and questions of scope and coverage. Finally 'production values' address questions about quality, engagement, and appropriateness.

One point made earlier in respect to *Gödel Escher Bach* noted that the book used a multifaceted approach to developing its concepts. This lowered barriers to acceptance by providing more than one way to get to grips with ideas. Given that the population at large demonstrates (at least) three different dominant modes of thinking (basically linear-aural, linear-textual, and visuo-spatial) this suggests that expositions in all of these modes should be offered, with the student being offered any mode at any time, although this choice is optimised around a favoured mode (which would require no action to maintain). A second variable would be the rate at which material would be presented. This involves allowing simulations and animations to be operated at user-controlled speeds and the possibility of multiply regressive additional explanations which would be of an essentially remedial nature. While this is in principle far more powerful than merely going over the same point in the same way again and again, which is useless if there is a key point missing or forgotten, it does require that far more information be prepared than would be ever accessed by any individual on a 'just-in-case' basis. Again this material would have to be prepared to the same standards as everything else and is potentially the biggest single obstacle to the entire model. There will be an assumption throughout that the body of knowledge presented will have to be self-contained so there is little or no scope for using the rest of the Web as a resource for when the self-contained expositions run out of steam. There are also navigational issues in respect of deeply nested regression which need to be resolved. (The same solution can be used in connection with navigation after a search.)

The key technology needed to make this all work is user profiling[12]. Here the profile needs to keep personal information like the rate at which the student is progressing through the material (with comparisons of typical progress rates through particular chunks) and the dominant mode of presentation which will affect the entire presentational and interaction style. The profile will also need to keep a record of the progress the student has made against the course objectives, which will have to be broken down into micro-objectives against which a Boolean tick or quantifiable measure is recorded. It is important to emphasise that there is no suggestion this tool would be used for formal assessment and this would have to be carried out entirely separately. There would typically be periodic questionnaires, however 'dressed up', for the student and these will be constructed with the express intention of showing evidence of meeting specific course objectives, but none of these would be used to formally grade the student. Typically such a questionnaire would include devices to aid the student to the answer and the extent to which they were used would contribute to the assessment of progress in completing the micro-objective. However it would be the student's overall behaviour, which provides far more varied information than questionnaire response, which would determine the nature of the presentation, and choices offered, from moment to moment.

Technically this requires keeping a database with individual student profiles on them and these would need to be initialised although this need require no more than a list of log-in names and passwords. As the profile develops the information it contains would be of great value to potential assessors and it would be important to keep this information both private and uncontaminated. The student would be positively motivated to co-operate here if uncontaminated data assured the most helpful presentation and data perceived as unfavourable was kept out of the final assessment. Such a compact would give the student the freedom to try things out while the system was at its most supportive. Aggregated profiles would be useful in comparing typical behaviour and areas

[12] This makes the cheerful assumption that the 'usual' issues in preparing publicly disseminated material are addressed properly, namely authoring, production and content maintenance, even IP rights. All of these are non-trivial issues but there is plenty of experience in managing them. IP may turn out to be the worst problem because it is not in the interests of the benefactors of the present system to release their hold on it. In the meantime unpicking copyright on a case by case basis could become a quagmire from which individual projects may never escape.

needing more development. All of this would be in jeopardy if the system were also used for formal assessment, so we make a clear separation. In such a situation it would be possible to contemplate on-line note-taking and markup aids kept private to the individual.

Other technical issues involve navigation and data management. In respect of navigation it is evident that the site would contain a huge amount of data so some kind of internal search mechanism would be required for browsing or look-up. While conventional IR techniques are applicable here, the state of the art in video retrieval involves speech analysis to the audio track to generate relevance sets associated with particular parts of a video stream. Again the style of reporting here would take preferred mode into account. Essentially there are three ways of navigating through the material, free-form (in which the user is in complete control and selects the path taken), guided (in which a navigation engine presents material in a recommended order), and reference (where a search engine is used to locate a particular topic or issues relating to a topic or keyword). Free-form and reference may take the user anywhere in the material and so require site maps to aid the user in self-location and direction-finding. A site map is not a passive thing but requires an engine to present the map in a meaningful way and allow location and path-finding enquiries. In essence it is part of the search engine but most search engines do not support such a resource. The other part is the style of query the user is allowed to make. We would prefer free-form enquiry of the sort made popular by 'Ask Jeeves' or the style of inference analysis as in the 'Rabbit' database system.

The data management issue relates to the scale of the data which needs to be kept. Given that typically any topic will require many multiples of additional topics to be developed, and that this process is potentially endless, a decision would have to be made about what was going to be put in and what left out. Inevitably this leads to a process of experimentation to see what students actually do. Where they run out of steam is an indicator of what needs to be developed next.

The next issue is that of pedagogy. Here we are not asking questions about how, or even in a sense, what, but how effective this highly resourced approach will be. In one respect the technology will enable the same material to be repurposed for life-long learning agendas, namely in respect of a presentation engine which moderates the nature and rate at which material is presented. This is essentially controlled by whatever objective tree is provided but there is the problem of scope, where one might expect a life-long learner to plumb the limits of regression if these have been previously set by development in academia. One could imagine the process working more reliably if migration was in the opposite direction so long as the standard was reached, so this limits the adaptability of courses aimed at an intermediate academic standard when repurposed for senior secondary, life-long learning or retraining.

The real pedagogical issues concern effectiveness. It is understood how to present tightly-reasoned subjects like mathematics[Ske71] yet the approach suggested by Skemp is quite at variance with usual academic practice. The idea of using different modes has within it the *a priori* argument in favour of this approach being effective, and one of the many lessons of *Gödel Escher Bach* is that multifaceted approaches reduce barriers to understanding at the cost of expanding what has to be taken in. It is not merely basic modes of presentation which matter but also differing ways of getting the same semantic point across. This in turn suggests that each unit of knowledge will need its own ad hoc tricks, each replicated in as many different modes as are appropriate, to lower barriers to acceptance. Fortunately it is commonly the case that the more subtle or difficult the point the larger the collection of facets gathered around it. Nonetheless it becomes a scholarly as well as a creative issue to contribute to these corpora. The technology also allows for measurement. Setting aside moral issues we will have to face later, if we use the aggregated measurements made by the system, it becomes possible to identify the more and less effective pedagogical elements based on measurements of difficulty and preferred forms of explanation. This assumes our measurements are themselves reliable and, if so, that we can interpret them correctly, which means first, calibration and second, dimensional analysis. Although perfectly feasible it is not a simple task extracting unbiased results from such measurements, something which is more familiar to psychologists[13] than, say, historians. Measurement, and understanding these measurements, which is essential to determining effectiveness, is still a research issue here. What isn't a research issue is its feasibility. It can be done.

There are deeper questions about students being misled by a helpful system into thinking they have grasped something where they have not, but this can be tested in a separate process of assessment. Again, setting moral issues aside, this would involve comparing deductions from measurement with separately compiled test scores. There is little understanding of dimensions of effectiveness and what there is based on the self-motivated elite

[13] The study of HCI or Human-Computer Interaction is commonly carried out as collaborations between psychologists and computer scientists, so that comparison would be misleading.

cohort which no longer exists. We are all journeying out together into the unknown here; a student cohort we don't understand being handled by methods of whose potential effectiveness is unknown (but which just *might* work). What we do know is that the proven methods are increasingly failing.

The third and last issue is the one which is the main one we want to address in this paper, albeit not at length, namely that of production values. Here we are concerned with competing for students' attention with compelling media like film, public broadcast radio and television and computer games. We are also concerned with avoiding empty production values, which add nothing to the student's experience, or maybe even subtract from it. There is an old saying from the days of chalk-and-talk that if you can't explain it with white chalk, coloured chalk won't help. It is pointless spending a lot of effort on aspects of reinforcement which do not have any significant effect on success outcomes. At the same time this is not to say that improvements in production values are not worth striving for. We have all had the experience of being enthralled by first-class presenters while being embarrassed by poor ones. The argument we are entering into here is the same one which makes a clear distinction between an award-winning professional feature film and Uncle Jack's home movies.

The distinction here is between the making of a feature film and a theatrical play. The theatrical experience is limited by the need to do everything in real time in front of the audience at a cost which will cover receipts (give or take a subsidy or two). However, there is scope for a degree of interaction with the audience and in principle no two performances are exactly alike. The film experience is different. It is not made in real time and in principle every frame can be crafted to achieve the desired effect. Even a single play will be performed by teams of actors who vary over time, each performance requires the action of the whole team for every audience, and the production values themselves will be quite variable. The film will always have the same production values (given deterioration of the film-stock) and every experience will be the same for the same audience. The team who make the film do their work just once. These are just the conditions in which 'the best drives out the rest' will apply in the film World whereas it is a much weaker force in the World of the theatre[Pat99].

In the same way a 'teaching' website can be crafted to provide a much more appealing experience for the student. The Stanford experience, where students were quite happy to review low production value lectures, could be enhanced simply by ensuring diagrams, demonstrations and notes were clearly visible, made good use of the 'screen real estate', and were technically correct. Other aids, e.g. means to make on-line notes and to control the flow of the presentation could help although the reinforcement process itself would have to be tied to the lecture as given, errors, if present, and all. This suggests that the Stanford model is more like the theatre than film, as is the Caltech model referred to earlier. What is desirable here is to break the linkage between presentation and reinforcement to the extent that any visual or audio coverage of the material be done in a different way, possibly using devices not really suitable for the theatrical style of a formal presentation. The sorts of things we might be thinking of here would be the option of seeing a mathematical derivation developed as an algebraic or geometric animation with various options being available. e.g. going through the steps at user-controlled speed, inviting the students to put the steps in themselves, or interrogating the step to establish its origins. Sometimes animations are valuable in giving insights impossible any other way, as for instance in *Sorting out Sorting* (Toronto University) or *L6: Bell Lab's*[14] *Low Level Linked List Language* , each of which is famous in the World of computer science for the easy insights which these imaginative animations have given in an otherwise hard to grasp context. Other examples include Robert Winter's CD guides to various musical pieces(e.g. Stravinsky [Win96]) and the Which [Whi00] guide to GCSE mathematics and Science CD-based reinforcement courses[15]. A lot of progress could be made here by simply collecting together existing examples of best practice, and either re-working them for the new medium or repurposing them within it. These last are more like the feature film model than the theatrical one.

May aspects of what we have discussed already have a bearing on the quality of the experience, but what we are concerned with more than anything here is appeal. The sort of appeal we are looking for is more like that of immersion in a computer game than immersion in a feature film. The difference has been described by some as 'lean forward' vs. 'lean back'. Essentially learning is a 'lean forward' process requiring cooperation from the recipient in identifying what needs to be reinforced or built upon, and narrative is a 'lean back' process with the narrator taking and retaining the initiative. Too often the academic teaching environment can deteriorate into 'lean back' for many reasons, but primarily because timetabling dictates when something is going to be taught, whether the student is ready for it or not. This doesn't mean that we keep in 'lean forward' mode all the time, and

[14]Bell Labs is now Lucent

[15] The observation by one tester that a particular mathematics revision CD has awakened a hitherto non-existent interest in mathematics was one of many inspirations for this piece.

we can allow the cognitive effort to be relaxed by narrative parables of one kind or another[16], usually under the student's control.

One model we are particularly keen on developing, namely the multi-disciplinary course[Pat01.2], involves allowing the student to wander around through courses which may provide a common theme, or contribute source material to each other. Here the model is that the student will opt for being managed in one discipline (the major discipline) and the other disciplines are essentially offered in minor mode. In this case a profile may be built and developed for activities in the minor mode, but only micro-objectives relevant to the major discipline are monitored. Questionnaires become like quizzes on general knowledge (there may be a competitive element). There are two reasons for advocating this model and one warning. The first is that sometimes students have certain expectations of a course which, by its very nature, aren't delivered. A good example is that of computer graphics which often attracts students because they think they will learn to be graphic artists, but go on instead to learn a lot of mathematics they often can barely cope with. Given the option of seeing how computer graphics tools can be applied to achieve visual effects, a core topic for a computer graphics arts course, students can both be motivated to return to the maths and to learn some design skills on the way. The same course in major mode could be directed to graphic artists who may want to know enough computer science to understand why the tools they have work in the way they do, so as to better understand the usage of the tool, or even to help specify better tools. Thus allowing graphics artists to 'wander into' computer science can benefit them just as much as allowing computer scientists to 'wander into' their domain. Two courses, targeted at different student cohorts, can thus enrich the experience for the 'other' cohort when both are free to exploit others' domains. The other reason is more sociological. It is possible that students will be forced by circumstance to rely on a reinforcement tool to the exclusion of formal presentation and exercise[Pat99]. Here the assumption is that residency has become devalued for the student for one reason or another (economic reasons seem to be the most obvious, but health problems also come to mind). In a normal residency situation the student has plenty of opportunity to 'sample' unrelated topics typically at second hand. Where the student is forced to rely on reinforcement or distance learning aids then this aspect of residency could be devalued along with the rest, if these aids were totally focused on a single subject. With the multidisciplinary approach this aspect of the residency experience is enhanced rather than devalued.

The warning is about loss of focus. In a single environment in which a student can cruise freely from subject to subject there is the possibility of the student being drawn in to being spread (too) thinly across the whole range of material on offer. This risk is always there but it is a peculiarity of the computer environment that it tends to 'suck its users in'. Students often exhibit bizarre displacement behaviour ahead of important exams, and computer games are a favourite. While the use of the reinforcement site is to be encouraged at this point, how dangerous is it going to be? I can't help feeling that the materials on offer, however seductively presented, cannot do any harm, but there is an argument here in respect of a certain amount of restraint, or at least caution, in deploying these production values. Some understanding of these issues, and the psychology that drive them, is current in the media industries.

5. Conclusions

People like Frances Cairncross[Cai01][Econ01.1] are skeptical of e-learning because they have never seen a convincing exemplar for reinforcement of, let alone substitution for, traditional practices. To the best of my knowledge nobody has attempted to put together a reinforcement model with any of the extensive machinery and materials discussed here, so its still a case of 'absence of evidence' rather than 'evidence of absence'. On the other hand there is a non-zero possibility that it could all become too successful and actually damage people. The deployment of high production values here has to be monitored with caution, and their use is clearly a subject of further research, both in respect of effectiveness and of addictiveness.

If the MIT initiative in putting lecture notes on the Web is intended, as has been claimed, to pre-empt the polarisation of scholarship then it is highly unlikely to succeed. The models discussed so far seem to assume the lowest common denominator in respect to media , namely text-based materials which can be downloaded. In this respect the Web is simply acting as a distribution medium for free materials. Being available for free this may engender a certain amount of resistance to the highly resourced high production-value knowledge products we are discussing here, but in the end this will have no impact on the market which these products are targeting, namely the 50% plus of the present student cohort who are insufficiently motivated by a wholly passive take-it-or-leave-it presentation. Worse, the high production value products will elevate charismatic individuals to the

[16] Or quizzes couched as entertainment but having an underlying educational intent. These, however are 'lean forward' although their presence is for the same reasons as the 'lean back' elements.

level of academic superstars even though they, just like film actors, may be no more than the front people for teams which include recognisable figures from the World of film-making like directors, producers and editors. Indeed, in this situation the lone academic devising their own 'spin' on the material they want to present, then presenting it in their own way will disappear. That same academic will certainly introduce the material in formal presentation but there will be strong pressure to use some of the reinforcement resources in that presentation, also pressure to stick to the programme that the reinforcement tool addresses. This is a sociological and economic issue which has its dangers for the future of academic teaching.

Most academics would agree that such polarisation would be highly undesirable and, indeed, would be resisted by arguments which would ultimately be seen as self-serving, and perhaps by other means. When scholarship is concentrated dangerously in the hands of a few, there are serious risks of distortion as 20th century history has demonstrated again and again. A model for a possible way out is not the MIT solution which is, in fact, a crude attempt to do what we are about to advocate. Instead the Open Source[Econ01.2] movement in software design offers a possible way forward[17]. The Open Source foundation has published a contractual arrangement known as copy-left in which any open source software used as the basis of further development by a commercial organisation has to be passed on according to the same terms on which the base software was obtained. Essentially Open Source software is available for fee download in source form over the Web, so the basic copy-left agreement obliges derivatives of that software to be available on the same basis. It is not the task of this paper to discuss the implications of this for software but something similar could be done in respect to course reinforcement materials. Academics are now in the same position as the people who fix up errors in open source software or contribute new elements to it. The problem with this model is that, to be managed properly this requires a full-time team to edit and sign off on the changes that external contributors propose and the model for how this team is paid for is not clear unless the copy-left agreement allows only limited free usage based on level of contribution. A more practical difficulty is that the Web is the ideal medium for these kinds of transactions but it is highly unlikely to be able to provide the necessary bandwidth for some time to come. The important point is that the polarisations we have discussed are not an inevitable consequence of the model, so resistance on the basis that it is inevitable, is just bogus.

A more serious problem arises over the concept of profiling, a key issue for a reinforcement model. The direct source of the problem is the Data Protection Act which limits the time during which personal data may be collected and retained without registration. While this poses essentially solvable problems the reason the rather heavy-handed provisions of the Data Protection Act exist at all is because of concerns by the Public about the extent and accuracy of data being collected about them. The morality of such a collection process has also been called into question[Dra01]. Draper points out that there is a spectrum of attitudes to personal monitoring but generally speaking the correct approach is to make people aware that they are being monitored and why, and give them the option of switching it off. User profiling is intended to benefit the user, for example if they fail to demonstrate the entire set of micro-objectives in a single sitting (a tall order) but also require profiling data to be deleted, then they will be presented with the same micro-objectives all over again at a later session. There may well be suspicion of the use to which such profiling information will be put and it is certainly the case that a detailed profile would be far more revealing about the individual than perhaps they would care for anyone other than themselves seeing. Accordingly the data would have to be carefully protected, perhaps allowing students to provide their own encryption key (which would have to be entered at each session) but certainly containing provisions against unauthorised third party access, such as system-managed encryption. This in turn means that any data for aggregation, such as is required for measuring average behaviour is collected on the fly. Essentially the use of user profiling requires that there be an implicit compact with the student that the data be kept private, that it isn't used for formal assessment, and that it isn't used for any purpose other than for collecting anonymous, aggregated data for system tuning and the needs of the profiling process itself. The student should be allowed means to put in his private protections or to disallow the data collection process in whole or in part, although the assumption will be that the normal mode will be for the system to manage its own protections – which would include encryption off password data – and collect and use all profiling information normally.

In the rush to implementation there are still a number of unresolved research issues. These fall into the same categories as we discussed in the model already, technology, pedagogy and production values. The technical research issues include those of structuring knowledge systems of this kind, including and especially the knowledge components themselves. The pedagogical issues include those of interpreting properly the results of profiling and aggregation and how to modify presentations in the light of profiling data both on-the-fly and in the long term. Finally the production value research issues include questions of effectiveness and addictiveness. In

[17] This author doesn't yet understand how Open Source can lead to viable commercial (for-profit) models.

the end Web-mediated reinforcement turns out to require collaborations between software engineers, educational psychologists, and media producers, but they all still have to understand properly how to play their parts.

A big objection to all this, of course, is expense. Even the well-understood problems seem horrendous, but this is a market in which 'the best drives out the rest' (or 'the best is the enemy of the good'). If cost limits the effort put in to reach a standard then someone with deeper pockets, although not necessarily more talent, is likely to be able to overtop that standard. In marketing terms it is received wisdom[Lew96] that it takes a factor of 5 to drive out a previously dominant product (taken as having at least 78% of the market), but only a modest improvement to drive out a merely leading product (around 50% of the market). To have even 50% of an educational sector market would be to expect an annual revenue in the order of seven figures in US dollar terms which could easily justify a budget of the order of 1 –2 years expected revenues, but to a competitor who knows the numbers! The danger is that this is going to be an exercise best described as 'last man standing' in which the last person to put up the biggest budget gets to become dominant for maybe a generation. The answer to the problem of expense is that, if you think its too expensive you can't afford to try; if you do enter the market you have to spend what it takes, otherwise in the end you are wasting your money. The only ray of hope is that there is some form of the Open Source model which can be used to finesse the last man standing. This would be in the best interests of scholarship also.

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Capability Formation and Competitiveness in the New Creative Industries

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The creative industries are recognised as an area of above average growth, characterised by high rates of product innovation, the opening of significant new markets, and the potential to add value to a wide range of goods and services. They are a focal point for the application of new information and communication technologies and as a spearhead of more flexible working practices, role models, career patterns and enterprise structures. They offer the potential to open new opportunities for individuals, and they are considered a key aspect of both export and local regeneration strategies.

Despite increasing attention, there is still no full understanding of the characteristics, problems and opportunities of a this field of creativity and culture-exploiting work. The common processes and structural features which may be said to define the cultural industries have become evident relatively abruptly and continue to be transformed by new technology applications. Industrial and occupational classifications and public perceptions of productive work and substantial employment still reflect a corporate culture of standardised mass commodity production meeting basic needs with a plannable division of labour (the "Fordist" economy). This paradigm also characterised what became recognised as the 'culture industries,' that is those which used technologies of mass production and communication to disseminate commoditised culture. While many of those those structures continue to exist, the new economic paradigm in which the creative industries are prominent is characterised by a networked culture of flexible organisations re-inventing their capacity to anticipate and supply timely goods and services for diverse and rapidly changing requirements. In this economy the boundaries between employment, self-employment and employer status blur and "Portfolio careers" are widespread.

This paper will consider how such a dramatic transformation could have come about and examine the its implication for the contribution which education makes to the creative industries and in particular in recent business initiatives involving the creative application of information and communication technologies. Related issues for training and business support , considered in other papers, may be brought into the discussion. In the absence of an adequate statistical frame for longitudinal analysis across this paradigm change in the economy, we will draw on surveys of workplaces, supply chains and longitudinal studies of careers, particularly studies which I directed in London between 1996-9 on behalf of Middlesex University and Haringey Arts Council for the Cultural Industries Training Consortium, Government Office for London and the Higher Education Quality and Employability section of the UK Government Department for Education and Employment .

In this paper, I will focus on:
-the changing terms of competitiveness behind the emergence of 'creative industries' from the field previously know as 'cultural industry
-the relevance of different curricular models in higher education as preparation for success in new cultural enterprises.

From `culture industry' to creative industries

When culture industry emerged as a substantial reality, it was as particular way of thinking about mass communication.[0] European Union policy defined a "cultural industries" sector as including : film and video production, music production, performing arts, multimedia, printing and publishing, and information-based industries including electronic communications. Cultural and creative work not perceived as integral to media and communication was marginalised or excluded. However, "creative work is the source of all cultural products, even if it is no monopoly of 'the artist'" (Sinclair 1996, 1). The creative roles embedded in making, whether the object is one of linguistic, visual or material culture were soon to emerge in their own right, as the communication technology and business organisation progressively adapted to more discriminating and culturally active consumers. Employment and earnings from the organisation and production and transmission of media diminished, while those contributed by origination on the one hand and interface with the consumer on the other grew both absolutely and relatively. (Pratt 1997) Addressing consumers increasingly appreciative of cultural difference and originality, producers became aware of the importance of a timely distinctiveness in making markets and adding value across the fields of material culture, leisure, entertainment and even health services.

The enhanced cultural sophistication and initiative of consumers has involved more than simply disseminating what was once understood as 'culture' on the one hand, or harnessing creative work to a mass entertainment and leisure industry on the other. It has become more appropriate to speak instead of a democratisation of creativity linking fundamental changes in culture, technology and the economy. Evidence for this could be seen in the substance, directions and pace of cultural innovation and influence, and the demand for greater autonomy, range and facility of access to and control of cultural materials by a growing proportion of consumers, as well as in the increase in the proportion of time spent by them in creative activity. Growth of the number of professional cultural producers and those who wish to become cultural producers has also been significant. (Lury 1993, Hill 1996, Towse 1997, Whyatt 1997, Putnam 1999, Robinson 1999)

Creative consumption has been surprisingly pervasive, but most strikingly evident among young people. As Roger Hill pointed out in surveying the extensive range of the products of cultural industry which an earlier understanding of culture would have regarded with a dystopian eye:

> Young people select and discard a huge range of available material, ideas, words and images with impressive speed. The past and other contemporary cultures provide them with material to create an individual style. Strangeness and difference, aspects of the other, are particularly valuable to them in establishing the unique character which will guarantee their presence in the world. Young people require flexibility of the things they take over. Their great skill is in transformation. They can make ordinary and mundane objects special with new uses and combinations. They adapt and they invent. Their language is precise, original and distinctive. They experiment with sensuality, the feel of substances, the pleasure of properties and material goods. (Hill 1997)

Growing appreciation of the competitive significance of content, context and creative agency in a globally competitive framework of flexible and responsive business organisation has had important effects on perceptions of key roles and sectors in the economy. [i] The way in which cultural industries have used communications technologies has led to the spaces of producer and consumer becoming more equivalent, and cultural industry acquired a new meaning: rather than something outside of and working on culture, of something which incorporated a definition of culture which could be assimilated to the industries of mass communication, it has emerged as industry informed by and oriented towards cultural agency, or creative choice in a defined context. The cultural industries became "those industries which transmit meaning and which involve creative input," as Montgomery put it in an important transitional discussion (1990, 20). This focuses attention on the processes which link origination, transmission and consumption across a range of enterprises which may differ markedly in character.

"The arts," willing or not, find themselves among the cultural industries. "A Blur pop video and Damien Hirst's short film at the Hayward are the result of the same creative process, one funded by a record company for profit, the other by the BFI for loss. Which one has a better claim to be called art? Both are produced within a cultural production chain, which separates the cultural industries from the leisure and entertainment industries." (Sinclair 1996,p. 1) In the definition employed by Urban Cultures, Comedia and the London Planning Advisory Committee (LPAC) in 1994 the core elements of the cultural or creative industries were: "the performing arts, the visual arts, literature, printing and publishing, the crafts sector, the audio-visual and media sector (including new technologies), and fashion design, [while] there are other sectors in which creative input is secondary but still a crucial means of enhancing the value of products in the cultural industries: industrial design and graphic design (including advertising)."
(London Arts Board 1996, LPAC 1994)

In this definition, media and communications, while still relevant, is displaced from its previously central position by artistic creativity and creativity-led development. It falls some way short, however, of acknowledging the whole of economically significant cultural and creative activity. There are employments and organisations within education, entertainment, retail services, and government and voluntary sector programmes which would have to be considered in a comprehensive analysis of the dynamics of culture-led economic development, as indeed would aspects of the informal economy and its interface with social benefit. Because it conflates distinctions concerning the scale of production or reproduction with those concerning the definition of creative roles in a division of labour, it cannot show where and why creative input is of primary importance, or where we are talking about new industries in the sense of industries supplying new goods and services, as distinct from new ways of carrying on existing industries. To do this it would be necessary to define the common working characteristics of cultural enterprise and of the cultural economy , so that the roles (which may or may not constitute distinct

employments) essential to competitiveness can be identified, e.g. origination, manufacturing and production activities, support services without which cultural activities could not operate, and non-originating managerial roles.

Such research is needed to show how far the polarities of the broadcast era are being reversed, so that creative innovation is the principal spur to cultural business growth and communication with appropriate markets or audiences a constraint which is being eased by more intelligent and flexible communications technologies. It would also provide models of how cultural enterprise is manifestly driven by the expanding demands of diverse agents: relational, dynamic, experimental, self-transforming, moving in myriad directions, and producing cultural artefacts which present themselves as multiple, variegated, adaptable, and above all, timely.

Common and increasingly interrelated characteristics of cultural work can already be identified. Cultural work, whether in discursive, visual or material form, will be proficient in itself but also aware of its situation; necessarily discontinuous, it requires repeated re-invention; carried out substantially on individual initiative, it feeds on exchanges of information with sources, peers, critics and clients, and therefore involves flexible working practices and steadily increasing use of new technologies. In contemporary cultural business, agility is more important than size, initiative can arise at any point and travel in any direction, and volume, quality and originality may be complementary rather than divergent business strategies.

Recent studies which have considered the structure of employment and patterns of work in the cultural industries recognise a problem of defining employment modes and roles accurately which is exacerbated by changing roles, multiple employment and the prevalence of self-employment and 'freelancers' who may be variously (and alternately) temporary employees, self- employed or even employers. Subcontracting has been generated by corporate outsourcing of work to reduce overheads and achieve greater flexibility in respond to changing levels and patterns of demand. But beyond this, self employment has been chosen by increasing numbers with the capacity and motivation to undertake creative roles even when the economic rates of return are uneven and uncertain. Conditions of production and consumption have favoured more such initiatives by lowering the costs of entry and raising the relative rate of return for distinctiveness and responsiveness. These developments have taken many experts by surprise; viz growth of turnover and number of businesses and employment in cultural sectors have become less determined by the business plans of existing firms. Statements based on employer surveys to the effect that there only exists x need for cultural industry specialisms have repeatedly proved inadequate, as new entrants have made new business. Our study found that graduates in particular fields have played a particularly important part in creating new products, services, businesses and modes of work.

Forming creative capability

Where has the supply of talent for the new creative industries come from? Where and how are the capabilities and orientations formed which have fed this expansion? The capacity for successful creative work is formed in a medium-term process of education and self-education which typically parallels and interacts with the vocational context rather than preceding it in a conventional sequence. Until recently, many cultural occupations did not have qualifications as an entry requirement; however, cultural workers today in Britain are twice as likely as other employees to have a degree: 32% as compared with 16%. In addition, many people in the sector hold qualifications at a high level which are not classified as degrees (in dance or drama for example) Learning-on-the-job and working one's way up through the ranks are still common forms of training. These traditional education routes are declining however, partly as a result of competition for entry from increasingly well-qualified candidates (Cultural Trends 1995b, p29).

In this context, recent studies of early career patterns of graduates in the creative sector provide important data confirming qualitative and anecdotal evidence to the effect that British art, design and media education has provided a substantial proportion of this growth - feeding both the increase in numbers and innovations in goods, services and methods of organisation working and marketing. Further, when practice and project based art and design, and media production, and performing arts graduates early careers are set alongside those of academic media and communication studies and languages and literatures, the differences are striking. Art, design and performing arts graduates record:

-a stronger motivation to pursue particular careers and have chosen ideal careers closer to subject
-a greater degree of satisfaction with the realisation of their career plans

-a high degree of ingenuity in initiating and combining a variety of professionally relevant work and business opportunities

(Putnam et. al. 2000)

Remarkably, this pattern remained constant as the number of graduates in Britain doubled during the 1990s. Creative graduates have found or created new employments for themselves in their chosen field of work, and in the process sparked off important innovations in goods and services including new types of products. They have also filled a number of roles other than that of artist or maker in these industries. This data could provide valuable insights into the dynamics of the cultural economy: how careers are built where there are no career structures or personnel officers, where new business comes, how supply chains are organised and key information attained. It also highlights salient characteristics of art and design education: instilling the capability for creative initiative and making appropriate use of a wide variety of skills and knowledges.

It is worth noting that in contrast, with their opposite numbers in some other European countries, British art and design students are more likely to have engaged in the academic study of culture and formed a degree of academic competence. Such capability has a wide applicability beyond the named degree subject, and the expansion of the cultural economy referred to above has provided fertile new fields. The combination of creative capability and critical competence has helped these graduates to be self-educating and proactive in their careers, opening new areas for creative work in the process. They have taken well to building the portfolio careers characteristic of the new economy of networked creative agents, providing inputs of qualitative and quantitative significance. As the numbers creative graduates increased in the mid 1990s, so has their employment, and the overall level of activity, in the sector. This may help to explain why the growth of multimedia has been particularly rapid in Britain, in comparison to countries where art and design education has remained in an artisanal or atelier mode, and is not so well prepared to deal with rapid cultural and technical change.

That art and design and performing arts graduates have been more likely to establish themselves as pro-active self-managers, and innovative life long learners in the first few years after graduating, is a comment on the effectiveness of a critically contextualised, practice-based education. Again the comparison with more conventionally academic educational patterns in other fields impinging on the cultural industries is instructive. Although analytical work and problem solving figure strongly in all these disciplines, art design and performing arts students learn how to integrate large complexes of considerations and to manage to achieve a staged approach to practically implementable results, in the process acquiring the ability to devise original approaches and solutions. Thus they exhibit as graduates appreciation of a wider and better-integrated range of intellectual, technical and transferable abilities which they have drawn from their courses. They have also greater than average exposure to work experience and work-context awareness, which is retrospectively considered important in career building and correlates well with indices of relative success . These findings are borne out not only by questionnaire results but also in the supplementary programme of interviews which was designed to elicit the dynamic aspects of career management. (Putnam et. al. 2000)

Nevertheless, the curriculum might be further improved as a preparation for the new creative economy. More attention could be paid to integrating appropriate technologies, work experience and awareness, critical and creative challenge and opportunity to practice self-management. What is more striking is the finding that art and design students (as distinct from those in the performing arts) may lack awareness of many acquired strengths until their value is proven in work contexts. Many of these graduates may enter the world with an inappropriate lack of confidence, given their relative strength in key employment and self-employment abilities. Certainly, a majority retrospectively wish to have had more preparation in self-promotion. The high incidence of self employment in many preferred areas of work is bound to intensify this awareness and render the needs for self-promotion more complex, as does the increasing extent of movement between and combinations of form of employment. Cumulative self-evaluation or profiling and peer assessment could reinforce the qualities of art and design education and help lay the groundwork for a realistic awareness of relative strengths. Formative assessment of various stages and aspects of design can also reinforce the learning of relevant approaches, methods and competencies, so long as it does not diminish the integrative challenge of producing a final result - an invaluable formative experience which serves art and design graduates well in the cultural industries. Relevant work experience, especially work on project teams with non-art and design people also helps build a grounded confidence.

As the creative industries expand the effectiveness of contextualised creative education in forming a powerful set of capabilities is becoming more widely recognised. The complexity of roles in the new cultural industries is considerable and or programmes fusing art or music with technology studies. The evolution of music technology as a field is discussed in a paper presented to this conference by Carola Boehm, which delineates the consequences of different possible ways of defining and articulating the components of the curriculum and emphasises the significance of the institutional context within which interdisciplinary provision is made and the character and depth of related research and real-world applications. This discussion suggests that the effective integration of technological sophistication into creative projects achieved in several music technology programmes may be higher than that commonly found in alignments of product design and engineering, or of computer science and the visual arts. Where engineering education models have been highly directive and oriented towards the inculcation of knowledge, the experimental project work essential to integrating knowledge and fostering creative insight and initiative are marginalised. Such weaknesses are accentuated if inadequate grounding is given in the terms of reference and methods needed to found and ground student creative projects. The ability to define projects which have the potential to be recognised as significantly innovative is arguably the most important key to professional advancement in the creative industries. The scope for subsequent creative initiative is considerably extended by challenges to take into account orders of experience beyond those which spontaneously arise or are given to the intuition of the student. Awareness of relevant contexts of production and consumption and the ability to organise effective interventions in these contexts adds considerable value to career trajectories in the creative industries.

A range of curricular experiments with combinations of aspects of information technology, business and cultural studies have attempted to cultivate this sort of capability in students who want to work in the cultural industries but lack the experience or orientation to undertake an art, design or performing arts degree. Where such programmes are merely combinations of course units from different disciplines and not backed by substantial interdisciplinary collaborative experiment by staff with 'real world' applications, they may be regarded as speculative, if not opportunistic. Where staff engagement suggests how they may be configured so as to create interesting tensions and synergies between the different elements staged to build increasing levels of self-direction, confidence and ambition, they may contribute something of value to competitiveness in the new creative industries despite the fact that the graduates lack training in a recognised 'creative' discipline. Students on such programmes who gain work experience and undertake substantial projects will form some of the capabilities that a degree in art, design or the performing arts making can produce. However, such positive results cannot be achieved by simply juxtaposing elements of discrete disciplines. Unless the programme is centred on learning how to form as well as execute projects they are not likely to cultivate the degree of critical insight, originality of conception, independent initiative and integration of competencies presently fostered by art, design and performing arts education. Further, the ability to analyse cultural process is particularly relevant to both individual success and sectoral competitiveness where the pace of cultural change outstrips even that of technical and organisational change.

Although the results of these surveys are broadly encouraging about the fit between at least some sectors of higher education and growth points in the new creative industries, many issues remain to be addressed. Some employers contend that graduates lack sufficient understanding of industry circumstances or particular technical preparation. However, graduates themselves contend that much of this is best learned on the job. More significantly, many graduates find that their talents cannot be effectively utilised by employers. For example, CIRCUS industrial visits in other EU countries confirm survey results from Britain which show that managements, even in the e-commerce sector, may not yet appreciate that design for optimal communication today, even in Business To Business, differs substantially from that of the era of print based publicity. If senior managers and client representatives lack elementary understanding of the cultural implications of new technologies they may neglect the advice or fail to utilise the expertise of more aware employees and consultants, leading to missed opportunities and substantial risk to investments. A problem of this kind will not be remedied by changes to higher education curriculum or conventional employee training.

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[0] An opposition between cultural origination and mass consumption is characteristic of the age of mass production, where reproduction or broadcast technologies played a predominant role. (Benjamin 1936, Adorno and Horkhiemer 1947) Critics held that culture depended on a knowing and edifying audience involvement, contrasted with the mere consumption of material goods; *culture industry* would reduce "spiritual" culture to "material" consumption, obviating its civilising potential. In a broader sense , culture may be considered "....a particular way of life, which expresses certain meanings and values not only in art and learning but also in institutional and ordinary behaviour." (Williams 1977) Cultural forms are embedded in the made world, in ways of life, as well as in recognised 'cultural' objects. Before the industrial revolution and the separation of high from popular culture which preceded it, 'industry' simply meant 'busyness' and 'the arts' stood for all kinds of making. From the standpoint of genteel refinement, however, industry, even more than commerce, demeaned all in contact with it and ` cultural industry' could only be an oxymoron.

Behind the culture industry debate lay a recognition that the organisational and technical aspects of large scale reproduction and dissemination would not only change the interpretation of existing cultural artefacts but lead to the creation of new kinds of cultural products and new kinds of cultural producers. One had only to look to the silver screen for evidence of this and suggestions of how cultural value and authority , education and entertainment could be affected. On another front, the techniques of mass production and consumption were being applied to cultural content and creative processes to conjure up a different kind of cultural industry, that which embraced advertising, graphic and industrial design. Such activities grew steadily in importance until they came to stand for a new kind of economy, oriented towards consumption for all and increasingly turning on extensions of consumer choice. This new context had profound affects on perceptions of culture and of the nature of cultural industry . One sign of this was the evaporation of a didactic tone in British advertising during the 1950s , which spoke of a sea change in the character and location of cultural authority. Further, non-canonical and even non-elite sources of cultural production became connected with the new techniques of dissemination and find larger markets than established cultural forms. By the late 1960s, culture could be considered a matter of the creation of meaning and a feature of communication. This definition of culture reflected and served the new mass communications industries, providing additional evidence that the cultural industries, in dominating key cultural processes, were usurping cultural authority and value.

[i] Creative roles began to acquire a higher profile from the mid-1980s. On one hand, the economic significance of "the arts" attracted a new kind of attention. On the other, Training and Enterprise Councils discovered complexes of cultural industry in attempting to determine the focal points of 'creativity and innovation' in the economic geography of their areas. Understanding lagged behind events, and in 1996 it could still be necessary to insist in discussions of the cultural industries, that "Creative work is the source or all cultural products, even if it is no monopoly of 'the artist' (Sinclair 1996, 1). However, with the publication in 1998 of the DCMS Creative Industries Mapping Document and the Crafts Council's Learning Through Making, followed in 1999 by the report of the National Advisory Committee on Creative and Cultural Education, All Our Futures: Creativity, Culture and Education, creative work has been recognised as significant in economic policy and given a prominent place in educational policy stage. (Robinson, 1999, pp 48-53)

On the Coherence of Sonic Space

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Abstract

Sound, as a physical phenomenon is dependent on space for its articulation. This paper attempts to define a number of issues concerning the creative use of sound in relation to space. Recent technological developments stimulate an integration of a number of conditions previously confined to disciplines such as music, architecture, or sculpture. The author's creative work in installation art and composition is used as a platform for examining structures which are able to provide modes of interaction between sonic worlds, physical and virtual space. The use of acoustic measurements of spaces has become central in the author's compositional processes. Inter-media coherence is examined as drawn from spatial perception in physical and virtual worlds; the architectural and acoustic experiences of moving through space are described as complementary attributes.

Keywords:

Sound Space, Acoustic, VR, Electroacoustic, Architecture, Sound Perception

Sound, as a physical phenomenon is dependent on space for its articulation. Our perception of sound is closely connected to the physical environment in which that sound occurs. Most modes of sound production imply a physical enclosure; be it a violin body or a concert hall. In different ways, these enclosed spaces modulate the vibration of a string or the sound of a voice or instrument. I propose to explore the notion of sound as a spatial phenomenon and its implications, not necessarily from the point of view of acoustics but rather from a philosophical stand-point which informs my creative approach to designing sound works.

Acoustic space

An enclosure can alter the nature of a sound source dramatically. A room acts on the localisation, timbre and clarity of a source and adds its own spectral content through resonance and reverberation. The phenomenon of resonance[1] is often related to an empowerment of a sound source, as a physical entity resonates with a given impulse. Any tone with a frequency close to the characteristic resonant frequency of an enclosure will be reinforced with the sympathetic vibration of the air within that enclosure.

Resonance gives us a sense of sonic space. We perceive relationships between pitch/spectra and the physical characteristics of an object or enclosed space. Size, shape, density and mass can to some extent be identified through this quality of sound. These elements provide us with clues to how any given object will sound. We are able to differentiate between the resonant qualities of an object (e.g. a metal plate) and the resonance of that same object sounding in an enclosure. The resonance potential of a physical entity can be abstracted from its general sonic capacity. Resonance can be thought of as independent from other modes of articulation of an object (i.e. piano resonance is released simply by depressing the sustain pedal, or by shouting into the strings as well as by playing the actual keyboard). Every enclosed space contains resonant potential; often a sub-product of architectural or sculpted form. We articulate this resonance by speaking or playing a musical instrument in a room. As with a violin body, this room will modulate whatever source is played in it according to its own resonant spectrum, reinforcing and neglecting certain frequencies. Wind players often shape their vocal cavity as if they were singing the note they play on their instrument to produce a richer sound. The mouth and throat are used as a way of extending the resonance of the instrument. The mouth is a sophisticated resonator which allows for the creation of an enormous number of pitches and timbres. Enclosures of different size and scale function with similar mechanisms.

[1] Resonance - the intensification and enriching of a musical tone by supplementary vibration
b: a quality imparted to voiced sounds by vibration in anatomical resonating chambers or cavities (as the mouth or the nasal cavity), 1994-1999 Encyclopedia Britannica, Inc.

Architecture : Articulated space

Once we expand the scale, and imagine gigantic violin bodies, flutes 10 meters long, plaza-sized piano sounding boards and start connecting them, we enter an architectural domain. By enlarging a violin body to the size of a room we will be interfering with its normal qualities (especially those which make it function as a violin). The entity of the violin much sense to still think of the violin as an instrument (except perhaps in a metaphorical sense). We have created an architectural space which acts as a modulator of sound energy, which articulates sound. Acoustically, we produce a particular behaviour of resonance, reverberation, etc…
A striking point remains: we are inside a violin - inside a machine from which we release musical potential. The exploration of this construction is then left up to us; we translate the action of generating sound with strings and a bow to the process of listening. Our performance becomes the spatial articulation of listening.
The perception of sound involves our whole body in a different way. The arm movement of bowing a string becomes the movement of the whole body in a spatial listening situation. Our physical movement within a space acts as a filter, as a way of focusing listening.

The body and aural perception : localisation, directionality, depth

The idea of one's body as the centre of perception (Edmund Husserl - zero point of orientation) is particularly relevant to sound – whereas one can be a (visual) observer, treating the world in front of us as a spectacle viewed from a certain perspective. Aural stimuli are mapped around our own body, lending an experience of intimacy and involvement which is not present in visual perception. Sound space occurs around a listener. Our whole body acts as a moving ear, performing trajectories in the exploration of a sound world. Sonic space is read by our body through a series of cues which allow for orientation. Immersion into resonance makes us react/interpret a sound space which now houses the body.

"An image in motion will always capture your look, inscribe you into a direction. But sound, as long as it is not contained by headphones or an individuated space, must be approached, walked into, penetrated, and, in walking into it, as your body subtly moulds the acoustic around I, the sound will penetrate you."
Sean Cubitt (1998)

Navigable soundscape : simultaneity

We perceive aural space perspectivally: through images of how sound sources relate to the position of our ears. Each listening perspective implies an infinite series of perspectives. This induces us to change our position in order to investigate other sonic profiles. Sonic profile can be defined as an internal representation of a soundscape – an outline describing the superimposition of various sources, events and their sounding in a space. On this multiplicity of perspectives we impose a hierarchical sequence which leads to an optimal perspective. When looking at a painting in a gallery we are led by our initial glances to a point of optimal perspective which enables us to experience a specific object. The construction of this hierarchical sequence is dependent on the nature of our first glances – the sonic profile. Depending on the senses we decide to pursue, certain series of perspectives will have a stronger attraction than others.

One can map the soundscape according to the placement of sources and the limits of their diffusion. Spatial placement and trajectory (in the case of moving sources) are as important as all other acoustic parameters for the differentiation of layers in a complex soundscape. The possibility of physically moving through a soundscape introduces the ability to articulate a complexity of sonic layers, a sonic simultaneity which allows itself to be explored through space. This navigable nature of sound provides a point of departure for the design of virtual navigable worlds.
The acoustic coherence between visual and sonic worlds seems vital in a virtual environment, just as a certain type of structural coherence enhances our visual perception of a virtual image. In the case of a virtual design which parallels physical structures we process information based on what we see and learn about physical parameters such as weight, mass, material etc… We then assess the feasibility of that construction.
At an immediate level we question things like: "are these columns wide enough to support this platform?" We relate the virtual image to a parallel in the physical world and test its coherence.
In the case of virtual environments which set out to challenge physical laws we need to be convinced that they are constructed around a set of alternative coherences which allow for our inhabiting them.
The navigability of a virtual sound space resurrects the dream of open form in music. Through technology we can create a situation where each listener can in fact choose how to proceed through a piece of music. Certain decisions normally made at the time of composition are shifted to a performative action to be carried through by the listener. It is nevertheless important to think of the listener not making arbitrary decisions but rather a set of informed moves which allow for individual creativity. The process of creative listening and subsequent navigation is improvisatory by nature; we refer to it daily when taking aural cues from traffic to cross the street. We are dependent on those cues to make an

informed decision. Our virtual architecture must allow for this type of improvisation, which will render spatial structures into temporal sequences.

The architect Christian de Portzamparc considers time as an essential part of architecture.[2] Concepts such as movement and routes are of major importance. Space is rarely perceived in a "fixed" position. Even when not moving we construct a temporal sequence, a chain of events which make us perceive architectural works not as isolated spectacles but as a continuum of situations. Portzamparc relates this temporality in architecture to the musical experience. The negation of time in classical and neo-classical architecture (rendered in stable structures and symmetrical organisation) is captured in Goethe's phrase "architecture is frozen music". Portzamparc argues that it is not music that should be frozen but architecture which should be in movement, have the fluidity of music, invite perception in time.
My work attempts the creation of music structured in space through an architecture that invites temporal exploration. The sound installation *Partial Space* defines an enclosed space through sound. It renders a room as a sound-generating instrument where the audience acts as particles of energy. By moving inside this instrument, one makes it resonate. The space is divided into eight areas mapped to the frequencies of the eight strongest partials in a room's resonant spectrum. When in movement, the audience triggers these frequencies and disturbs the spectrum by generating "beating" frequencies. The simplicity of the generated sounds (sine waves) enables an awareness of both the individual partials as triggered by visitors as well as the synthesis/harmonies achieved by the faster movement of an individual or a larger number of visitors. The piece is structured according to a time cycle derived from the analysis of the frequency response of the room. A list of the eight strongest partials in this spectrum is taken at various time intervals. The intervals of the analysis (lasting only a couple of seconds) are extrapolated to a 20 minute cycle. In this way, the short time-varying spectrum is used as a structuring device for larger scale form.
I have applied similar processes to the composition of instrumental pieces. Here, a space produces a spectral system which is mapped to the pitches played. This approach is rendered in two distinct compositional attitudes. In the piece "Cecilia and the Four Dimensions", the mapping of instrumental sound to the room in which the piece is played allows for the use of the space as a resonator activated through its natural modes, as played by instruments.
In works such as "Instrument of Sabotage" a room's spectrum is transposed into the performance space. Here, several modes of resonance are juxtaposed; the scordattura in the strings provides the harmonic domain on which the piece is based. Through the use of string harmonics and other articulations (e.g. sul ponticello, pizzicato…) an extra spectral dimension is achieved. The piece consists of a series of impulse and decay constructions which are further modulated by the performance space.

Virtual (sound) space

Digital technologies provide a basis for juxtaposition of structures and narratives. Virtuality and the concept of cyberspace relates to the conquering of the limitations in physical space and time. Information technology allows for communication without the constrains of physical space. Hence, digital narratives often represent a space of freedom, commonly presented as an infinite utopic architecture unconstrained by boundaries or distances.
The creation of an electroacoustic sound space shares common issues with virtual architecture. The virtual experience challenges our relationship with space particularly in how we perceive our body. The fluidity in architecture that Portzamparc refers to is achieved through a simultaneity of spatial events which we articulate in time. A number of perceptual cues can be useful in designing virtual space. Our experience of sounds of low frequencies is related to the sensation of intimacy and interiority. This sense of immediacy and vicinity tends to evaporate as one moves away from the source. Because of their long wavelengths these low sounds are associated with a continuity in space, a sense of blurred boundaries; solid barriers take a fluid character as low frequencies are able to contour them. At the other end of the spectrum, high frequencies give us a different type of immediacy through unobstructed perception. High frequencies tend to define sharp boundaries reflected off hard surfaces, providing us with a discrete understanding of space.
The dialogue between visual and aural structures takes primary importance in our experience of virtual environments.

"…the sound and colour are received into my body and it becomes difficult to limit my experience to a single sensory department"
Merleau-Ponty (1962, 1999)

Merleau-Ponty's statement assumes a level of coherence which is present in a physical reality. The creation of a virtual world needs to somehow render these sounds and colours individually to enable their perception as a multi-dimensional entity. The aural and the visual act as two juxtaposed elements with characteristics which allow for our understanding of a place or situation. A visual support can substantially modify the auditive reading. If hypothesis derived from the two nodes of perception are not coherent, then, visual perception easily shifts aural perception without loss of meaning in our global understanding (e.g. in TV broadcast of concerts the focusing on individual groups directs our

[2] "Registres d'Architecture" Entretien avec Christian de Portzamparc, in Espaces

listening to that group, somehow compensating for the lack of spatial discrimination in sound).
Electroacoustic systems allow us to overcome physical constrains in room acoustics manipulation. Designing virtual spaces implies radical changes in the traditional practices of sound and visual creation. A spatial music requires spatial parameters to become part of the musical structuring, at the same level as pitch, timbre or rhythm. Recent technological developments in virtual acoustics suggest the possibility for the creation of an audio-visual space which shares a common physicality. A sense of immersion (in a real or virtual world) seems to be essential for triggering a series of physiological and psychological responses. Virtual immersive environments will no doubt produce their own listening modes, grounded on improvisatory performance. The capability for performance emanates from the rendering of our body as an entity in a virtual environment. A number of VR works are impoverished by the fact that there is no suggestion of our presence in the space. This is particularly disturbing in the aural field; the making of noise is at the centre of our perception of space. We construct sonic profiles in relation to the sound of our own body. With immersive technologies which can effectively render an interactive environment, it will be interesting to see how these body responses can be displaced and challenged.

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The Poetics of Interactivity: The Uncertainty Principle

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***"Negative Capability*, that is when man is capable of being in uncertainties, Mysteries, doubts, without any irritable reaching after fact and reason. " —** John Keats, letter to his brothers, December 1817

We are entering an age of narrative chaos, where traditional frameworks are being overthrown by emergent experimental and radical attempts to remaster the art of storytelling inside developing technologies. The maturation of New Media Art into a major innovation in screen narrative form and genres is recorded in myself and Andrea Zapp's new book: New Screen Media: Cinema/Art /Narrative, a collection of essays by leading cultural theorists, critics and artists using new media, which seeks to establish a clear overview of this changing territory. It does this by outlining the challenge interactivity and new media pose to the future of cinematic and broadcast formats of story. It specifically describes emerging narrative types in hypermedia, installation and video art, the Internet, computer games, interactive television and interactive film and relates them to classical film and drama theory.

Traditional narrative has been augmented by the advent of new media, not just through the revolutionary distributive aspects of the technology, but principally through the changed relationship between audience and author. New media forms offer both a convergence of narrative vehicles and a fragmentation of understood forms: the genesis of broadband, virtual and immersive technologies, together with the development of Artificial Intelligence (AI) and autonomous agency in interactive drama, inevitably change current screen broadcast and Hollywood models of cinema. The acceleration of technical development tends to ensure that the evolution of dramatic language can often be overlooked in the pursuit of a 'better' interface. The new narratives sometimes seem to be dependent on the speed of engineering, rather then on a developing conceptualisation of possible genres and their languages.

The discovery of ambiguity in the sub-atomic world was the essential catalyst for the twentieth century's abandonment of hierarchical Newtonian science; with its omniscient privileging of the observer.[1] Quantum mechanics, revealed through Heisenberg's Uncertainty Principle, provided definitive proof of the ultimately unknowable and unpredictable nature of the universe-all versions of reality were thereafter tied to the subjectivity of observation. As the ambiguity of fundamental particles raised a conundrum for particle physicists, so for artists, writers, and filmmakers (engaged in the experimental discovery of appropriate form and language for interactive story and drama), the rediscovery of ambiguity in the language and structure of narrative still poses a primary challenge. However. it is now the omniscient privileging of the author, as opposed to audience, which is under contention. In this paper, I hope to demonstrate some of the means by which interactivity and narrative can utilise the interpenetrative power of language to collapse the distance between subject and object, and between interior and exterior spaces.

The frequent assertion that interactive narrative is 'a contradiction in terms' centres on the argument that the diegetic space of narrative is compromised or destroyed by interactive engagement with story; as I hope to show, this argument is based on a misunderstanding of narrative mechanisms. The active participation of audience is not new nor is it disruptive of narrative diegesis; it is merely incompatible with certain narrative conventions, which have become unduly emphasised by historical accident.

Language and 'Deep' Structure

Writers frequently use complex strategies to manipulate the engagement of audience with content. These strategies often fall outside the normal complexities of the Aristotelian model of drama. Dickens, for example, was an episodic writer by practice and his plots are often thin or incredible to the critical eye. What we value in late Dickens, apart from his characterisation, is the vividness, energy, and *ambiguity* of his language; and it is through such language that the darker symbolic sub-texts of his narrative-worlds can reach an audience. [2] These affinities of language have been remarked in many great writers and form a secondary 'deep structure', which creates the unconscious mood of the work. We can also find equivalents to such literary devices in various cinematic genres such as *film noir*:

where complex plots have very little to do with the powerful unconscious effect of the imagery on audience mood, and may even defy logical analysis. [3] It seems to me that language is the perfect tool for overcoming the discontinuities and schematic thinness brought about by sudden shifts of timescale or viewpoint, typical of interactive narratives. The very flexibility of language allows both for a compression of meaning and a proliferation of association, which can simultaneously lend rich ambiguities of meaning and organic unity to a new media work.

Multilinear Verbosity

The Multi-lineal possibilities of new media are not in themselves of any advantage in developing narratives. Economy and compression usually are hallmarks of successful artistic work, and cinematic conventions are based on its powers of visual shorthand and suggestion, with the audience filling in the details (witness the montage theories of Eisenstein). Imagine the artistic disaster, if a film like *Groundhog Day* (Director:Harold Ramis 1993) were spatially mapped as an interactive story, in such a way that the audience could live through all the repeated days and detail of the hero and his discovery of community. A tale of redemption would become a circle of hell- and the audience would empty the cinema. Multi-linearity then demands two things: compression and precision

Story as Ritualised Landscape

Ritual and myth appear to offer a route for "deep" story. Narratives where actor and participant are one and the same, where the proscenium arch is dissolved, where landscape takes on symbolic significance, and where the usual hierarchies of temporal sequence, plot and sub-plot are suspended. In other words, the same model as early Greek theatre, carnival, and religious ritual.
In the *Dreamhouse*[13] project, my artist's group, Ship of Fools was seeking to bring such an experience up to date, combining spatial, ritualistic, and dreamlike elements. As in many other 'games' the user finds themselves in a house. A walk through the *Dream house* offered access to a number of rooms or experiences; each designed by an artist, reworking traditional storytelling structures. Various rooms were appropriately matched to the different psyches of those involved in authoring the piece. So the house became an interactive theatre, where different tales are triggered by audience exploration. The bland domestic environment of a real suburban house (in fact a real Barrett's 'Show Home' in a suburban estate at Bradley Stoke, the negative equity capital of the U.K.) [14] became the main interface.

In my own contribution, ***Labyrinth*** [15] various devices-doors, windows, mirrors and other objects, opened gateways into the mythological world. The themes of intimacy and alienation were explored through such devices as multiple talking heads, each with their particular poetic fragments, or through a hall of sleepers who could be individually awakened. I sought to employ the resonance of poetic verse drama to unpack a number of thematics around fatherhood, overwhelming passion and 'Real Politik' suggested by the original Theseus and Daedalus legends. The transition in Greece from the worship of the Goddess to Apollonian religion is explored in the myth, where the Frankenstein-like quest for knowledge has equally dire consequences for the inventor. Daedalus commits murder, loses a son, and creates the monstrous Minotaur through his overweening pride in science. The piece explores these themes through dramatised video and a verse structure, which utilised parallel monologues (or duologues), set in dialectic opposition for each linked pair of protagonists. The verse is constructed so that cross-counterpoints occur with every phrase. The verse reads vertically for the individual speaker and horizontally for each pairing. The freedom to switch video streams at any time allowed the audience to reconstruct meaning somewhere between the two opposing narrations. The development of irony and pathos demanded that no single monologue is privileged. Writing for such an interface involved a new and precise multi-linear approach to scripting:

Physical Space Embodying Diegetic Space

The main direction of my recent work has been in examining the nature of theatrical and interactive installation spaces where poetry can be re-imagined as a part of a hypertextual universe. In pursuing this direction I was attempting to synthesise aspects of cinema, video art and more primitive and associative spaces, to create a narrative form based in a physical environment, rather than on a virtual one. While in *Labyrinth* a more directly theatrical route was chosen, the ***Understanding Echo*** [22] installation was an attempt to root interactive narrative in a magical space corresponding to part of the audience's 'collective unconscious' where 'memory, dreams and reflections' [23] could rise to the surface. Language once more played a central role, one indexed directly onto a physical space.

In a darkened room hung a number of translucent panels, displaying large

digital photographic montages. In the centre space of these images was a shallow circular pool of water. In the silence of the installation the audience could make out the drip of water. Flickering in the pool was the image of a woman's face, submerged below the surface. From time to time she rose from the depths and talked slowly in short poetic fragments or aphorisms. The audience may not immediately have realised it, but the form of these spoken fragments became ever more personal as they approached the pool. The large changing digital montage projections around the pool also represent combinations of memory. (A similar strategy had been successfully used in earlier interactive works such as Lynn Hershman's *Lorna*[24])

The figure rising from the waters loosely corresponded to the nymph Echo, in myth forced to forever repeat the last lines of her lover Narcissus's speeches, trapped in a pool for all eternity. The form of the work also alluded to the female spirits that inhabit wells and rivers in various folklores, such as the Lady of the Lake in Arthurian Legend. as well as the drowning Ophelia in Hamlet. The woman reviews her life and the sense of powerlessness her situation has brought. The poetic fragments were intended to resemble a mix of colloquial musings and the timeless incisiveness we associate with poetic aphorism. They ranged from the general to the intimate. The woman is by turns embittered, flirtatious and coquettish, disillusioned and enthusiastic: ignoring the audience one minute; hectoring them the next. Her character moves through a wide emotional range, returning obsessively to her situation and the unhappy love affair, which caused it. The woman inhabits the present, but lives only in the past. Onto the audience she projects her loves and fears. We are immersed in her longings and become her blank screen: the spatialised narrative and the poetic monologues were fused together in the environment of the piece.

Once an audience enter the installation room, they have become part of the diegetic space of the narrative and are continually addressed directly or obliquely by the character of Echo. The precise sequencing or order of the fragments is irrelevant. There is no linear temporal curve involved. The more a visitor interacts, the more intimate the knowledge they gain of Echo's character. Thus the narrative is embedded in every experienced fragment. The difference between conventional literary narrative and this interactive form could be compared to the difference between a conventional photograph and a hologram. Whilst in a photographic fragment we see a part of a single perspective view, in a hologram each fragment of the photographic plate carries the total waveform of light generated by the original object. This holistic potential is what attracts me both to poetry and to interactive work. The immanent form is not only manifest in each part of the work, each fragment attains further resonance, meaning and 'negative capability' from the collection of other fragments and that meaning is subtly altered with each viewing.

Machines are not Poets

Naoko Tosa and Ryhohei Nakatsu [30] at ATR research Labs in Tokyo have created *Play Cinema*, where controllable avatars act under the audience's direction, creating new scenes from *Romeo and Juliet (in Hades)*, as the characters journey through the underworld. The dialogue and plot are unconvincing and by no means free-form. But at least here gesture-recognition and speech-synthesis, as well as facial and emotional-state recognition software, have been fused to create a variety of responses and variations on the basic plot. The neural net software is about as adept as a human observer at detecting emotional nuance in audience response. In an earlier experiment *Muse*, a software agent talked poetry to which the audience responded in preset phrases or in their own words. The animated "Muse" responded in turn with emotional expressions controlled through a neural network, that also recognised emotional nuances in the audience's own phrases. Most of words in *Muse* were previously developed by programmers, as were many of the dialogues in *Romeo and Juliet (in Hades*). There is obviously a long way to go before machines can properly attempt the precise art of poetry, and it is a moot point whether machine consciousness will ever have any affinities with human consciousness, let alone poetic sensibility!

Conclusion

The responsive nature of such systems opens up a potential new craft for the writer, where the encoding of mood, emotion and their syntax takes precedence over plot and and traditional forms of narrative technique. In the experience of any serious work of art, the audience must invariably map narrative onto a

whole range of cultural and historical references and resonances (a process conflated by Barthes as the 'Death of the author'). This process seems to be independent of whichever medium is involved. Interactivity by itself may never introduce closer engagement than that achieved by traditional art forms, even when autonomous agents in immersive environments conduct the narrative. Words alone are clearly not enough, but if used intelligently within such models they can, as I hope I have demonstrated, move us nearer to the serious works of art new media has the potential to deliver.

Footnotes

1 I am referring to Heisenberg's theory of Quantum Mechanics, outlined in the Uncertainty Principle Paper 1927:
"I believe that the existence of the classical "path" can be pregnantly formulated as follows: The "path" comes into existence only when we observe it."

2 Witness Alan Shelston, University of Manchester writing on the late novel "Our Mutual Friend":
"The convoluted plot, involving its central character in not two, but three, separate identities, all involving disguise, outdoes anything its author had contrived before; we are asked to accept concealed evidence, simulated behaviour and hidden secrets as part of the day-to-day processes of existence... Our Mutual Friend seems at times like a vast and somewhat decaying baroque structure, threatening at any moment to collapse. "
<http://www.lang.nagoya-u.ac.jp/~matsuoka/CD-Shelston.html>

3 For example The Big Sleep is notorious for its illogical and convoluted plot:
"The most famous loose end in the story concerns a chauffeur, one Owen Taylor, who turns up dead in a water-logged Packard, "washing around off Lido Pier." Questions on the set arose as to who, in the carnival of conflicting motives that made the film a Chinese box of mayhem, actually did kill Owen Taylor? Hawks realized he didn't know, and successive calls were put in to screenwriters Leigh Brackett, Jules Furthman, and William Faulkner; they didn't know, either. Finally, Chandler himself was reached; no, he said, he guessed he didn't know, either. (…) Hawks realized it didn't matter who killed Owen Taylor, and the film went ahead, its atmosphere of treachery somehow improved by the ambiguity."
Hagopian, Kevin Jack, "The Big Sleep" (10 Shades of Noir) *Images*, issue 2.
<http://www.imagesjournal.com/issue02/infocus/bigsleep.htm>

4 Ship of Fools group, Dreamhouse, CD-ROM, Research project on interactive narrative and new media at the Faculty of Art, Media and Design, University of the West of England , Bristol 1994-6

5 Barratt is a major UK home builder and has built housing estates up and down the U.K. As a consequence of the housing boom in Britain in the late 1980s and the subsequent slump, housing prices fell sharply in the early 1990s, leaving many home owners with mortgages far in excess of the value of their properties. Bradley Stoke in the South West of England experienced the worst negative equity problems in the U.K to the point where the town was nicknamed 'Sadly Broke'.

6 Labyrinth, CD-ROM and Installation, shown at ISEA 97 in Chicago and exhibited at F-Stop, Bath 1998 and Cheltenham Festival of Literature 2000, <www.sof.org.uk>

7 Rieser, Martin, Understanding Echo, Interactive environment, commissioned by DA2 and SW Arts for the Cheltenham Festival of Literature 2000
<www.sof.org.uk>

8 Jung, Carl "Memories, Dreams and Reflections", Fontana, London, 1963

9 Lynn Hershman's *Lorna*, interactive video disc artwork 1979, allows viewers to experience, and participate in, the life choices and outcomes of an agoraphobic woman. Lorna's neuroses are caused and exacerbated - by the invasion of her "home space" by electronic media. The Lorna persona is performed/experienced through her distorted possessions -a mirror, tv, wallet, watch and telephone -and viewers can access different disc channels by clicking on a hypertexted image of one or more of these, each of which confronts the viewer with a different series of "hot" social and personal issues. Each issue (abortion and the threat of nuclear war are two examples) accessed by the viewer, contributes to Lorna's agoraphobia, demonstrating how fearfulness seeps into many women's lives through mechanical media, leading them to reject the outside world. (See also Dinkla,S. Pioniere Interaktiver Kunst von 1970 bis heute, Edition ZKM, Ostfildern 1997, pp.170-195. *)*

10 Neesham, Claire 'It was the Best of Times... 'New Scientist' Vol. 162 No. 2181, Reed Publishing, April 1999, see also Creativity and Cognition. Conference Proceedings. University of Nottingham, 1999

Knowledge Management in Design Education

Aukje Thomassen; Emile Bijk

1 Knowledge Management

Since the early eighties, knowledge management has become a hot issue. Business researchers, consultants and media pundits from all over the world have exhorted today's companies to consider knowledge as an important aspect of production and a source of competitive advantage. Toffler (1981) and Drucker (1993) have described the transformation of western society from post industrial production (labour, capital and raw materials) to a society where knowledge is the predominant aspect of production and economic growth.

Trends in economic globalisation have led to ever increasing competition and shortening of life cycles of products and services. According to Porter and others, only organisations which are focussed on ever increasing added value will survive competition. According to Reich (1989) the recipe for survival in the post-industrial information society is the creation of organisations which value learning, creativity and the ability to innovate.

Institutions in higher art & design education are by nature organisations which value learning and creativity. Education and knowledge creation is the core business of these organisations. As such, it is quite remarkable how poorly developed the notion of knowledge management is at an institutional level. Although lecturers and educational staff put lots of energy at enabling knowledge creation and facilitating learning at a student level; very little organisations have developed a knowledge vision on how they can enable knowledge creation at an institutional level.

Universities are faced with the same challenges as other organisations. The educational market is not any longer the exclusive field of classic universities. Over the years consultancy firms, publishers and broadcasting companies have extended their services successfully into the realm of education. Local universities are faced with competition from abroad and the establishments of so-called 'in-business' universities.

Lifecycles of products and services are decreasing. The same applies to knowledge and information. Especially in the field of digital media, the lifecycle of curricula are challenged by the speed at which knowledge deteriorates. In order to meet these challenges institutions in higher education need to install a knowledge vision on how they retain and promote the creation of knowledge on an institutional level. In the LEDA project, universities in the field of design education, work together to apply aspects of knowledge management at an institutional level, by re-engineering educational practices and the implementation of information-management technologies. This paper reflects on the way LEDA caters for the creation of knowledge (within the field of digital media education).

2. Leda and its aims

LEDA (learning environments for the digital academy) is a partnership of four universities and an industrial partner working together to develop new educational practices and knowledge management systems to meet the challenges of education in the highly innovative field of design and digital media. The institutions were faced with ever changing demands and (technological) innovation in industry which was reflected by a strong demand of just-in-time knowledge at the level of courses and training. The institutions realized that meeting these demands would imply an assessment of the way knowledge creation was enabled on an institutional level and a need to focus on knowledge management strategies. As such the institutions focused on the potential of knowledge creation within research and project work. By designing new approaches to learning and the design of information management systems these institutions are trying to capitalise on the knowledge generated by students and educational staff within research and design programs.

LEDA will built learning environments which are specifically designed to facilitate and promote the exchange of student acquired knowledge, skills and attitudes. Where most learning environments are developed from a very traditional educational point of view, the LEDA learning environments are aimed at the articulation of both formal and tacit knowledge. The combined research effort of three universities in art & design has provided pedagogical mechanisms which promote the creation and exchange of knowledge.

The LEDA learning environments will be designed as a networked system that enables students to publish assets through intranet technology without prior technical knowledge. The LEDA technology will provide in fully configurable publication templates through which students can store and retrieve knowledge assets. Technological research will be conducted in the area of effective pre-analysis and filtering mechanisms as ways to enhance effective use of information within educational contexts.

3. About knowledge, information and Data

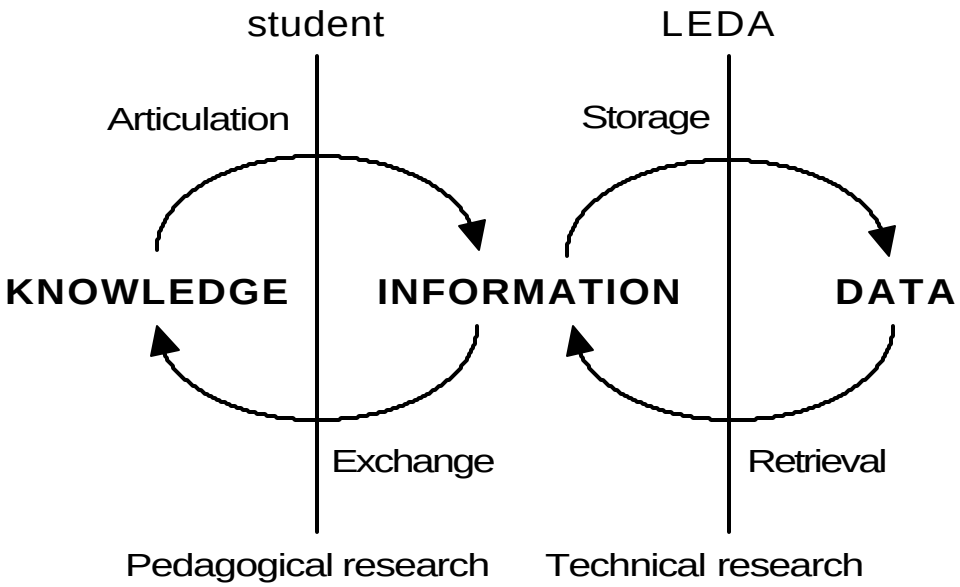
In writing about knowledge management there is a clear need to describe the differences between knowledge, information and 'raw' data. This paper makes the distinction in which data are merely figures, information is meaningful data and knowledge can be understood as information which is part of a meaningful social context like a social group, a specific knowledge system or a culture (Weggeman,2000). Following this definition, knowledge cannot exist outside an individual or a group. As a consequence of this approach, knowledge itself cannot be stored or transferred between individuals. In this regard advertisements of IT companies claiming technical solutions to knowledge management should be approached with reserve.

The only way knowledge can be exchanged is when knowledge is articulated into meaningful information. Articulation can be interpreted broader than just the codification of meaning into texts. Codification of meaning can occur by means of oral (speech, sounds, music), visual (body-movement, graphics) or even tactile codification.

Information in digital form can be stored and manipulated as data. The possibilities of manipulating, cross searching and storage of large data sets boosted the knowledge management hype. Especially the popularity and growth of the Internet in the mid nineties brought about all kinds of technical solutions to facilitate the logistics of data-sharing and

enabling the management of information.

The LEDA research combines both pedagogical and technical research to design pedagogical approaches to the articulation of knowledge and technical solutions to facilitate information management. The model below illustrates how the research in the LEDA projects is organised around the distinctions between knowledge, information and data.



Pedagogical research in the LEDA project is targeted on the organisation of knowledge creation processes in research- or project-teams and in what way knowledge is articulated as information.
The technical research is oriented at the logistic facilitation of information storage, retrieval and manipulation of data as technical enablers of the knowledge creation process.

4. The knowledge creation process

“Learning is a process of creating knowledge” (Weick, 1991) The definition of learning in this way implies that knowledge is both the input of a learning process as well as the output of a learning process. Learning, seen as such a cyclic process involves three types of learning activities: ‘collection of information’, ‘processing & synthesising’ and ‘creation and evaluation’ (Renger, 2000).

In this cyclic approach, the first stage is ‘collection of information’. Information to be collected can range from ideas, research materials or individual outcomes of prior learning cycles. In this stage of the learning cycle, information is collected for processing.

In the second stage, ‘processing and synthesising’ information is ordered, structured, valued, interrelated and synthesised into new knowledge. For example, research material is being processed to support concept development, whether in the form of a research report or a structured data collection. It is a collection of activities with the purpose of the transition from raw data, rough ideas, brainstorm session outcomes etc. to concrete articulated ideas or solutions. As such, this stage is highly process-oriented and not product-related.

The creating aspect of learning is positioned in the third stage of the cycle, 'creation and dissemination'. In this stage the results of processing & synthesis of information (from rough ideas to concept, from production to final product) is synthesised into new created knowledge which can be articulated in various ways (such as articulated ideas, models, presentations or prototypes) By evaluating the newly created knowledge, the cycle can be re-entered to create solutions for new problems or refinements on existing knowledge.

5. Enabling the knowledge creation process

LEDA's main purpose is to enable knowledge creation processes by using learning environments which facilitate the articulation and exchange of knowledge. In their publication "enabling knowledge creation" Krogh, Icchijo and Nonaka (2000) have defined key enablers which promote the knowledge creation process:

- Creating the Right Context
- Managing Conversations
- Globalising Local Knowledge

5.1. Creating the Right Context

Effective knowledge creation depends on an enabling context, which can foster ideas and facilitate the articulation, creation and evaluation of experiences and knowledge. As such the "whole process of knowledge creation requires the necessary context or "knowledge space". Knowledge creation can only happen through an organisational structure that reinforces enabling and is aligned with strategy. LEDA reflects these requirements by promoting knowledge articulation within the context of specific educational programs like project-based learning or the conduct of formal research at PhD level.

Creating a 'right context' is crucial to student-centred learning. Research into the facilitation of group projects that were carried out by students at the HKU showed that a critical factor to effective knowledge creation was the necessity for students to be physically concentrated in space. This sense of 'nearness' was crucial in stimulating the exchange of ideas, tacit knowledge and experiences, the provision of a stimulating social environment, and the generation of social pressure and a sense of mutual responsibility.

This 'nearness' was defined at first as a physical quality of the learning environment of students working in the same space, in terms of Euclidean distance. But students also extended their physical nearness to cyberspace using ICT tools as FTP, ICQ, email etc.

However, for co-operative learning to take place, more is needed than putting students together in space, whether it be physical, or in the case of LEDA, virtual. Students need to share a mutual frame of reference and structure which in LEDA are shared learning environments, shaped according to the pedagogical settings students are working in. LEDA will provide students with a work environment in which they can articulate their experiences and connect to intellectually related students or information.

5.2. Managing Conversations

"It is quite ironic that while executives and knowledge officers persist in focusing in expensive quantifiable databases and measurement tools one of the best means for sharing and creating knowledge already exist within their companies…Conversations" (Krogh, Ichijo, Nonaka, 2000). According to these authors good conversations are the cradle of social knowledge and the

most important enabler of knowledge creation.

Educational facilitators in student centred education do value the beneficial effects of conversation on knowledge creation processes. In coaching student groups educational facilitators often rely on conversations for the purpose of stimulating intellectual effort, promoting the articulating of progress and structuring the workflow. These Socratic dialogues stimulate students to articulate on the knowledge and learning experiences acquired and promote critical reflection. In the LEDA project the Socratic dialogue is translated to the digital domain.

The LEDA learning environments consist of pedagogical scripts which reflect the workflow a learning environment is meant to facilitate. These scripts consist of facilitating materials for the task at hand but more important, contain questions designed to promote the articulation and exchange of tacit knowledge. In designing these pedagogical scripts the dialogues are matched to the various motivations students can have in articulating their learning experiences, skills and knowledge:

- To comply to institutional requirements
- To share knowledge as part of the communal learning process
- To facilitate guidance and evaluation
- To showcase their work

One of the difficulties in designing pedagogical scripts to promote the articulation of knowledge in design education is to keep a good balance between articulation effort and killing the creative process by over-questioning students. A careful balance should be struck between registering crucial pieces of tacit knowledge while maintaining a good overview and representation of the entire design process. Striking this balance is very difficult, since there is not much existing research on how these particular processes take place in multidisciplinary group environments. The LEDA research aims to give insights into the underlying learning processes and procedures in art and design contexts in order to maximise articulation and exchange of knowledge while at the same time limiting the amount of knowledge-assets stored.

5.3. Globalising Local Knowledge

As the labour market in the field of digital media design is becoming increasingly internationally oriented, co-operation between institutions of higher education becomes increasingly important. However, international differences in curricula and course contents pose significant limitations on the possibility to design and distribute courses on an international scale. The knowledge derived from experience, however, is highly fit for exchange because it is not directly related to the specific contents of curricula, while keeping its relevance for students in the same discipline, and even across disciplines. As stated in the paragraph about the nature of knowledge, knowledge itself can not be transferred as such. Articulation of knowledge into meaningful information however, can be stored and manipulated by means of technology.

When retrieved in the right learner's context, mere data can acquire relevant meaning and become part of a knowledge creation process. The positive effects of the exchange of 'knowledge' assets depend entirely on the appropriateness of the data in the context of learner's activity. The LEDA technical research is aimed at providing solutions to the effective exchange of information. This research is once again related to the concept of 'nearness' as put forward in paragraph 5.1.

Here the concept of nearness is looked at from a contextual point of view, where it is projected on a subject matter which could share relevance with subject matter. An example of this principle can be found at *Amazon.com*, where a customer, whenever he/she orders an item, is confronted actively with items other people (who ordered the same item) ordered as well. In order to globalise knowledge in the context of the LEDA learning environments 'Nearness' can be defined as "the proximity value of information for knowledge (re)creation in terms of people working together and/or subject matter being relevant to people in a knowledge creation process".

Metadata are used to describe and define the context knowledge is articulated in. As such information inherits meta-information about subject-area and usage contexts. Matching metadata at the level of pedagogical scripts provide in so-called 'related topics, related issues, related persons', listings of potentially meaningful data which can facilitate knowledge (re)creation.

6. Conclusion and discussion

In the previous sections notions about knowledge management were illustrated with research associated with the LEDA project. A research and development effort to put knowledge management to practice in the realm of student centred design education.

The paper emphasises the notion of enabling knowledge creation processes as important aspects of learning. At this moment the LEDA prototype is being developed and soon will have its first educational evaluation within the EMMA and PhD programme at three institutes which run the EMMA and the PhD programme; The University of Portsmouth, Merz Akademie Stuttgart and the HKU (Hogeschool voor de Kunsten Utrecht). The results of these evaluations will generate data to test and validate the concepts as described in this paper.

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Net.Drama – Interactive User Participation in Networked Digital Environments

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The advent of new media presents a serious challenge to our understanding of visual representation, of narrative and indeed the whole art of the moving image. New narrative forms in hypertext, multimedia, computer games, interactive broadcast and screen media are constantly redefining the relationship between the creators of content and their audiences, who increasingly are becoming the co-producers of meaning. These and the following issues of theory and practice are related to the forthcoming book and DVD publication: Martin Rieser, Andrea Zapp, editors: New Screen Media, Cinema/Art/Narrative, due to be published by The British Film Institute (BFI), London/Center for Art and Media (ZKM) Karlsruhe, in October 2001.

In this context, my own artistic practice involves designing narrative models as creative and interactive environments for the user. As an extension of my studies in "traditional" film and media, I try to break from the linear plot line by actively integrating the viewer into the process of structuring the content. At the same time I am making a critical inquiry into the ongoing media evolutionary process - by mirroring and re-framing classical art mediums in new digital structures be it literature, theatre or film.
The open structure of the Internet offers the most appropriate configuration to play with audience participation as an alternative form that could enrich our concept of media. I am trying to discuss and critically examine issues of interactivity and virtual forms of representations, of the body itself and parallel of a dramatic model. Interactive platforms based on a real time networked infrastructure can be designed as accessible environments for the viewer. Content systems can be set up that are actively shaped and further developed through the influence and contributions of participants from various remote locations. Over the past years the majority of my projects have therefore required the active participation of the user within the drama - by slipping into a virtual performance role. The fiction is then melting together with the users' personal backgrounds and contributions in these works – creating a *docudrama* in a networked context.

"Technical visions are social fiction (…) Technical visions are directed towards correspondence of the body and towards co-ordination of behaviour. They are daydreams born out of social connections directed towards other social connections."[1]

The narrative itself functions like a frame and starting point to experiment with a self-dynamic open construct of storytelling. This refers directly to the Internet, which I personally see not only as a pool of predefined information, but rather as an open source model and world of hidden characters - used here as a conceptual basis. The general idea is therefore to constitute a seamless portal to the net itself as the main source material, making the borders between the individual and the theatrical room less obvious. In that sense I am also intending to open up parallels to the cinematic process by replacing the actor as a type with the participant's own personal complexity, to fill the media space with content. The more the viewer develops creative or even pantomimic skills and ideas, the more he or she motivates their partners and the more the story can mature as a user driven scenario of cause and effect. A shift and acceleration in perception and action takes place: from distant viewer to emotional participant, being forced into a role within a spontaneous episodic play.

"Face to face interaction and verbal communication is loosing primacy, while at the same time the complex heterogeneous computer transmitted, telemedial presence is increasing. Identity and physical integrity become an art form since understanding one's own individuality through the anonymous, hetero-anonymous and pseudo-anonymous, the body has become a style through which to deal with media environments."[2]

The following two examples give an overview on these aspects of research in the field of user driven *net.drama*:

1.
Little Sister - a CCTV Drama and 24 hours Online Surveillance Soap (www.azapp.de/littlesister)
is a web based project, in which live user action and performance was implemented with parallel video streams in a timeless and circular montage system. It went online in spring 2000, combining the potential suspense of live web cam images with closed circuit television and global surveillance camera sequences. The interface or starting page shows snapshots of a local town area and its corners, shops, flat entrances and inhabitants, referring to the typical spatially limited set up as a unique code of the TV dailies. The images are arranged in a circular hemisphere, to remind one of a surveillance mirror as found in a department store. By dragging the mouse over the image fields, a focus effect appears on every single picture, to symbolise a focussing camera shot. Hidden behind are over twenty online links to webcams spread all over the world, observing private

and public locations, which represent typical soap opera locations, such as the office, the kitchen, the corner shop or the hairdresser salon. They open in small non-resizable windows, which can be arranged parallel or opposite to each other on the screen. Little Sister experiments with the interface of the split screen, in which different live actions are streamed in parallel or associative modes in the same time span, although the cameras are often operating in different time zones. The user is allowed to choose his or her personal casting in this timeless virtual drama from a familiar array of urban images. This open control of dramatic display is set in contradiction to the rigidly designed interface. It transport an open-ended narrative, based on discovering a random routine of live incidents in public and private locations and at the same time it plays with the viewers' expectations and notions of voyeuristic media technology. The online sources depend only by conception on the author. There is no influence on the live-streamed content, on the focus points and when (and also whether) the camera is switched on. As a consequence, the project forms its own virtual social system, where the webcam space itself directs the flow of time, image and action.
By linking to private cams and live CCTV in one context, *Little Sister* draws finally a very thin line between the free choice of self- exhibitionism on the net and the limitations of movement through visual registration in media society. It is intended that the user vacillates between feelings of curiosity and oppression. It leads to a subordinated change of role and perception: the virtual observer could also possibly be the detected one and vice versa. The circle is closed back on the narrative impulse itself: A 24 hrs Online Surveillance Soap.

2.
A Body of Water
In this project I collaborated with the British artist Paul Sermon to make use of an open ISDN-video-conferencing network structure to explore direct real-time interaction and coexistence of multiple participants in a visual/virtual environment. The user actively takes part in initiating as well as processing a story, within a sensory meeting space. The narrative growing from this is integrated in a very site-specific context.
The project was realised for for the Connected Cities Exhibition at the Wilhelm Lehmbruck Museum in Duisburg, Germany in 1999. Taking place in the Ruhrgebiet – the "black country", the event reflected through new media art installations on the tremendous changes in working and social life and culture, caused by the disappearance of heavy industry. The main of the installation was set up in the Ewald/Schlägel and Eisen coal mine in Herten, using the impressive shower and changing rooms (Waschkaue) and connecting them via the network to the museum in Duisburg. The mine itself has been closed down since 1997. Over a 1000 miners per shift were using the Waschkaue each day and it was once one of the largest coal-mines in Europe, employing over 7000 miners.

The installation occupies three spaces, the chroma-key room at the Wilhelm Lehmbruck Museum in Duisburg, the changing room and the shower room in the Waschkaue Herten. The audiences in Herten and Duisburg are connected in the following way: A video camera in Duisburg captures images of the audience standing in front of a chroma-key blue backdrop, this image is sent to Herten via an ISDN video conferencing system. The image is received in Herten and chroma-keyed together with a camera image of the audience in the Waschkaue changing room. The chroma-key mixed image is then video projected onto a fine wall of water, sprayed from high-pressure showerheads in the Waschkaue shower room. A camera situated next to the projector captures an image of the projected image and feeds it to three monitors in the changing room space in the Waschkaue, and back via the ISDN video conferencing system to three video monitors in Duisburg.

The water wall, or screen, is located in the centre of the shower room and has two different images projected onto it simultaneously from either side. The audience is able to walk around the water screen and experience the images changing from a telematic link with Duisburg to black & white documentary footage of miners showering in the original Waschkaue. Floating independently on each side of the water wall, the two images are not mixed and appear as completely different scenarios from either side of the water screen.

The work simply wouldn't exist without the water interface. It transports the public interaction and at the same time it reflects the area, the Ruhrgebiet, as a network of rivers and waterways. The shower room is the heart of the installation, all the visual and conceptional layers meet here. The water screen mirrors the disappearance of heavy industry through the disappearance of the body in the data network and so refers to the present changes of industrial culture in the region: On the one side the viewers are confronted by the new era, the interactive platform of networked communication - a possible future? - yet on the other side they discover the ghostlike shadows of the past miners showering in the water - a flashback to the abandoned space and its former working culture.

"Andrea Zapp and Paul Sermon construct a water world in *A Body of Water* in which volatility and fluidity of communication are carried and changed by water. The users of the installation show their other interacting partner - who is located at another site - his or her outlines as images on walls of fog that change in a constant flow. The water removes the ideological appearance of longevity and constancy from the images, which are exchanged between both sites live via ISDN. It washes the image clean, one could say, and must then

immediately continue with a heraclitic conclusion: One can never view the same image twice. (Just as one can never set foot in the same river twice.) Presence and history are in the current of constant change. The authenticity of the interactor and the historical relevance of the images recalled in the mind are flowing, or rather information that has flown away. We can let this information flow on, divert it dam or disperse it, but we can never freeze it: information flows!"[3]

1 Fassler, Manfred. Stile der Anwesenheit. In: Felderer, Brigitte, ed. Wunschmaschine Welterfindung. Vienna: Springer Verlag, 1996, p. 260 (transl. A. Zapp)

2 ibid. p. 271 (transl. A. Zapp).

3 Catalogue statement by Mathias Fuchs. In: Dinkla, Söke, ed. Connected Cities. Processes of Art in the Urban Network. Ostfildern: Hatje Cantz Verlag, 1999, p. 209

Ergodic Art and Computer Games

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This is not a keynote. This is a test, partly initiated by Simon Penny and partly by my continuing interest in influential and fabulous conceptual failures in new media theories. This time the main focus will be on Lev Manovich's recent book *The Language of New Media*, but I might also briefly discuss inherent contradictions or problems in comparative media studies (Henry Jenkins), remediation (Jay David Bolter and Richard Grusin) and the post-human (N. Katherine Hayles).

Maybe I should also explain how this presentation was composed by applying time stretch and end-synchronized delay -- to borrow a concept or two from Trevor Wishart's excellent keynote that among other things made very clear that the avant-garde is not buried in Photoshop as Lev Manovich would want us to think, but is still mutating in the minds and works of certain artists.

This talk was originally written as a regular paper for another academic conference, mysteriously cancelled, and in order to maximize your intellectual effort I decided to collapse the text and its footnotes into one discontinuous continuum without telling you which is which. This procedure should guarantee that my output is full of temporary and permanent, flaunted and suppressed, focused and diffused, and epistemological and ontological gaps to exemplify the well-known theories of narrative comprehension developed by Russian formalists and their successors like Meir Sternberg, Brian McHale, David Bordwell and Edward Branigan to name only a few. All this is necessary because my topic, Ergodic Art and Computer Games, refers to practices that are more than merely interpretative. It's time to begin again.

There's no easy way to go around the conceptual mess regarding the so-called new media. The usual theoretical approaches to it are either tautological in oh so many non-heuristic ways or somewhat montypythonesque -- defining digital or networked and programmable media as something completely different -- be that favourite other theatre (as in the works of Brenda Laurel and Janet Murray), cinema (Lev Manovich), comics (Scott McCloud), or misread and badly applied continental philosophy (George P. Landow). These fundamental confusions give rise to an endless array of slightly smaller, but already institutionalised or at least well established and influential confusions concerning qualities such as interactivity, non-linearity or embodiment. If well marketed, they will create just the right hype to alienate the enlightened segments of the interested public. So it is not all bad.

However, my point of departure is at least a little different from those. I'll begin with Espen Aarseth's cybertext theory, which I don't take to be so much about texts as about the cybernetic production of signs and the unique dual materiality of this production. Some time later I'll try to expand or exhaust it in relation to sound, vision and movement, mainly through computer games and something that might be called ergodic art. In between I'll apply a slightly adjusted version of Aarseth's theory to four different cases loosely labelled as comparative media studies, remediation, the post-human, and the language of new media. I have selected these paradigms and some of their main representatives for closer examination because from my point of view they exclude far too many interesting, attractive and heuristic practices and traditions from consideration. I have no doubt that when I'm done with this little test you'll tell me things I want to hear and things I don't want to hear, not to mention things I should have known. So let's see what happens.

In cybertext theory the elementary idea is to see a text or a work of art as a concrete (and not metaphorical) machine consisting of the medium, the operator and the strings of signs. The latter are divided into *textons* (strings of signs as they are in the text) and *scriptons* (strings of signs as they appear to readers/users). The mechanism by which scriptons are generated or revealed from textons is called a traversal function, the combination of seven variables (dynamics, determinability, transience, perspective, links, access, and user function), and their possible values. This combinatory approach gives us nearly 600 (576 to be exact) different media positions, where every text, independently of its medium, could be situated based on how its medium functions. Let me quote in detail: "The following variables allow us to describe any text according to their mode of traversal:

1. Dynamics: In a static text the scriptons are constant; in a dynamic text the contents of scriptons may change while the number of textons remains fixed (intratextonic dynamics, or IDT), or the number (and content) of textons may vary as well. (…)
2. Determinability: This variable concerns the stability of the traversal function; a text is determinate if the adjacent scriptons of every scripton are always the same; if not, the text is determinate. (…)

3. Transiency: If the mere passing of the user's time causes scriptons to appear, the text is transient; if not, it is intransient. (…)
4. Perspective: If the text requires the user to play a strategic role as a character in the world described by the text, then the text's perspective is personal; if not, then it is impersonal. (…)
5. Access: If all scriptons of the text are readily available to the user at all times, then the text is random access (typically the codex); if not, then access is controlled. (…)
6. Linking: A text may be organized by explicit links for the user to follow, conditional links that can only be followed if certain conditions are met, or by none of these (no links). (…)
7. User functions: Besides the interpretative function of the user, which is present in all texts, the use of some texts may be described in terms of additional functions: the explorative function, in which the user must decide which path to take, and the configurative function, in which scriptons are in part chosen or created by the user. If textons or traversal functions can be (permanently) added to the text, the user function is textonic. If all the decisions a reader makes about a text concern its meaning, then there is only one user function, here called interpretation." (Aarseth 1997, 62-64)

It is important to notice that the relation between textons and scriptons is arbitrary in digital media: that's the "essence" of its unique dual materiality – "arbitrary, because the internal coded level can only be fully experienced by way of the external, expressive level". (Arseth 1997, 40) There are other systems where there are two material levels as well, as in film with the filmstrip and the image on the screen, but their relation is not (usually) arbitrary. There's nothing extraordinary here; this conceptual dividing line mirrors the all-important distinction between database and interface, or the separation of the storage medium from the interface medium. Still, it is quite extraordinary that Lev Manovich does not even discuss this theory in his own attempt to theorize the same distinction.

Cybertext focuses on ergodic literature, where the user has to do non-trivial work or effort to traverse the text. This means activities like navigating, adding signs or programming, or configuring the settings or other parameters of the system with either temporary or permanent effects. Generally speaking the ergodic is everything that requires more from the user than mere receiving and/or interpreting. In that sense it gives an accurate description of the interplay between the user, the medium and the strings of signs, and could be used as a taxonomy of interactivity.

For example, let's take an ordinary movie and run its functional side through cybertext typology. It has static dynamics, as neither the amount of signs nor their content changes between or during different screenings; it is determinate, as there are no chance elements; it is transient as the signs appear at their own pace independently of the spectator; it is impersonal, as the user can't take strategic responsibility of the characters or existents in the film; it utilizes no links; the access to its parts is (temporally) controlled, not random as in ordinary books or videos; and finally it has only the interpretative user function, as every strategic choice the spectator can make concern the interpretation of the film.

To continue this trajectory of heuristics, the functional side of the medium is verifiable to a much higher degree than the usual interpretative and interlocked organisations of content and expression. So, if we want to begin with something indisputable and still not trivial, we could begin with describing this textonomical side that can be as dynamic, unstable and variable as the theory might seem to suggest in the first place. It's easy to imagine hybrids -- different parts and phases of the problematic totality having different operational values -- but that doesn't change the accuracy or the necessity of this type of description. The main thing is that this precise knowledge of the arrangement of a medium has enormous consequences for previous aesthetic theories, as they usually presuppose a medium that uses a very limited amount of these possibilities, sometimes only one of them. This is certainly the case with literary and film theories. The accumulated theoretical knowledge we have, including the most sophisticated narratologies, is gained from literary objects that are static, determinate, impersonal and intransient, with random access, interpretative user function and no links. There are other kinds of print objects from artists' books to Raymond Queneau's *100 million million poems* and the fictions of Julio Cortazar, to name only a few, but these are precisely the under or badly theorized works with neglected or exceptional features.

Similarly, theoretical knowledge gained from film studies is based on cinematic objects that are static, determinate, impersonal, and transient, with controlled access, only the interpretative user function, and no links. Obviously, there are audiovisual artifacts that have occupied other positions and nothing prevents us organising the usual cinematic display and the context of its reception according to other parameters. Still, this is not the way the most influential film theories approach, organise or reflect their shared subject. It is also worth noticing that most values of the usual literary and cinematic parameters are similar; this fact points to even deeper similarities between these two arts.

The heuristic potential stems from the fact that we can now provide 575 fresh alternatives before we even begin to deal with meanings and interpretations or engage with what is usually called the form of the expression, as in describing how the chosen audiovisual medium functions we are just dangling somewhere between the form and the substance of

expression. Obviously, later on in any analysis all these sides should somehow be connected to each other, but there's no sign of such work being anywhere but in its infancy. But for now, let's quickly see some basic alternatives to the traditional scheme to which both Godard and the dullest Hollywood mainstream equally belong.

Let's take time. As Lev Manovich discusses it, it comes in two forms, either as linear narrative or a recurring loop. However, it is trivially easy to imagine countless alternatives. Let's say an impatient spectator gets to see a hyperlinked Zapruder film. If he is happy in just receiving and interpreting it, he can continue watching it forever. A slightly more active spectator choosing links will get a much longer representation: if he makes stupid choices he will get the Warren Commission version, but if he is a bit more clever in how he uses his time he can get an equivalent of Oliver Stone's JFK. In addition some sequences or frames can be viewed only once, some others only if certain others have already been viewed, some new material will appear if the spectator has stayed around more 40 minutes or only on the second or third viewing, and if there is more than one spectator navigating the same dead Kennedys' file, only a very few of them will have the privilege of seeing the key sequences or frames or the unedited versions of them, and so on while the actual evidence slowly fades away. This is a trivial example of what could be done by playing with access and temporal constraints, that is, the usual cinematic condition.

The functional approach or attitude is some kind of middle ground between media essentialism and its montypythonesque variation, which lacks the shortcomings of these two extremes. It is legitimate to do what Lev Manovich does in the first half of his book, that is, piling up his favourite series of adjectives and properties describing digital media. In his case they are numerical representation, modularity, automation, variability, and transcoding. Little later in the book they are implied in the practices of montage, teleaction and compositing. We can take similar lists from other sources trying to tell us what computers are and do. The problem is that these descriptions, however accurate they otherwise are, are not heuristic and have little or no power to engender or even invent new practices, a property which at least to me is becoming more and more important. In Manovich's case this becomes obvious when he reaches the final layers of his exposition. When he discusses form he takes up databases and navigable space in ways that are vulnerable to damaging critique, as he seems to be unaware of competing aesthetic theories built up around these commonplaces. Quite surprisingly the main weakness of his approach stems from what he thinks narratives and games are in relation to computers and databases. He opposes narratives to databases without understanding that the latter can support various modes of expression (including narratives), which makes this crippled comparison and opposition as pertinent, heuristic and Borgesian as a hypothetical one between towels and washing machines. On top of this he ignores the formal specifics (rules, goals and the necessity of manipulating the equipment for starters) of another medium-independent cultural formation: games. That's how computer games became navigable spaces in his conceptual map of visualist colonialism.

The other alternative is not so great either, as things get even worse if we privilege any existing form of art and see computers and networked and programmable media fulfilling some half-imagined promises inherent to this or that tradition or older medium. It may give us some ideas of how to continue already well-established practices but that's all there is to that approach, and I guess everyone in this room knows or at least has an educated hunch that's not the whole story, the big picture, or the game we want to play.

By applying the functional media theory we can get rid of certain paralysing and always already aporetic questions. We don't have to know exactly how some medium works, or where its limits or most useful constraints lie now or in the future; we just have to describe how it functions as a machine producing signs (of whatever kind). That's not enough, as we also have to connect this side of the medium to more or less media-independent cultural forms of expression, like games, stories and performances for starters, without assuming everything is or should be reducible to them. That is exactly what Aarseth's theory does to the hegemony of narratives.

Aarseth opposes narrative with another discursive mode: the ergodic. There are countless other possible modes, but this particular one offers challenges and tensions that are far from being solved or resolved, and beyond that it might give us an unified field of study not reducible to previous territories and categories that yet remains media-independent. And this feature might come handy if we want to claim independence for an array of practices on the fringes of traditional art forms.

"Ergodic phenomena are produced by some kind of cybernetic system, i.e. a machine (or a human) that operates as an information feedback loop, which will generate a different semiotic sequence each time it is engaged." (Aarseth 1998) This kind of system has a potential for actualising itself differently every time it is used, which creates other than interpretative problems. In addition to the usual activity of constructing meanings, we must do non-trivial work to produce sequences of signs that are not necessarily shared by any other user. Thus the stable and continuous identity of the material foundation of the work of art is questioned, and we have to entertain the possibility that for every individual system we also have, to some degree, an individual medium. That necessitates yet another beginning.

Based on this rather condensed sketch of the ergodic we can discern three categories of systems. First, systems that concretise and actualise themselves in the same sequences of signs every time. We are talking about traditional art here, be it a novel, a film or a painting: the only thing we are asked to do is to interpret it, to experience it and to give some meaning to it. All this is difficult enough, and will remain that way. Second are systems that require non-trivial work from their user, reader, or spectator, and which have the potential of manifesting themselves differently every time they are used. This we might call ergodic art regardless of what kind of signs are produced, their source, their medium, or the spatial and temporal limits of their existence and appearance. We could counter the distinction between art and ergodic art by claiming that they both are interpretative practices; that whatever work we have to do in an ergodic labour camp we will do it in order to get something to interpret; we might have to configure and reconfigure the system to the best of our ability or curiosity, but our interests are ultimately interpretative. And that's probably true; the non-trivial work is usually not an end in and of itself. Or at least it is not very pleasurable if it is.

Thirdly, we all know there are pleasurable systems and modes that are not dominated by interpretative interest. I'm referring to games and computer games in particular. We have to interpret in games, but we do so in order to configure, in order to proceed from the beginning to the winning or some other situation. Games usually come with explicit goals, rules and instructions as to how to manipulate the equipment (whatever the latter is made of, and capable of in terms of sound, vision, movement, and action). By situating ergodic (or interactive, if you want to go back to unspecified banalities) art in between well-established interpretative practices and games, certain conceptual benefits are gained, as we have moved here beyond the much hyped beyond and can enjoy the luxury of conceptual double vision.

Before reviewing the benefits resulting from open and social rules and rewarded behaviour in the context of games, a critical misconception has to be addressed. This is the common assumption that computer games are a medium or a media. In practical terms this reduction is tailor-made for big media conglomerates that want to circulate the cultural capital they own through whatever distribution channel there is or will be. These interests also define everything sellable and marketable as a story for countless understandable reasons. Stories and narratives have much higher cultural standing than games, and this higher standing is desirable in cultures and prison societies, where retarded right wing movements can increase their power by claiming that guns and neo-nazis don't kill, but computer games and flight simulators do. Here we once again encounter political, economical, social and cultural interests running counter to the standards of decent academic scholarship.

We can take two examples, Henry Jenkins and his so-called comparative media studies and the concept of remediation coined by Jay David Bolter and Richard Grusin. However valuable they might be or however much sense they might make in other respects, their blind spots in relation to both media and transmedia dynamics are surprisingly compatible. They just want to do away with the whole question of specific media formations and modes. In particular, the concept of remediation carries worrying stabilising effects with it. Whatever new form, mode or medium there is, there's no time to study it and build a decent scholarship around it, as we are supposed to be immediately stuck with remediating it. It would be so nice if we actually knew what we were remediating before doing the deed. This approach obviously privileges the already well-established discursive fields and objects to which all newcomers are forced to assimilate. In the peculiar billion-dollar case of computer games, this strategy means there is no shortage of scholarly work tracing down even the remotest tiny similarities and overlapping areas between games and mainstream narrative and cinematic practices. Everything else will be excluded and ignored, almost in advance. The fact that stories and contents circulate seems to be good enough for these theories and theorists. And in practice computer games end up being remediated cinema instead of being remediated games (as they still were in Chris Crawford's *The Art of Computer Game Design* in the mid-80's) in Bolter and Grusin's model; in Jenkins' model computer games are just one story-selling and storytelling channel among others, maybe a bit different, but that difference is never specified or closely studied in these pannarrativist repetitive media studies capable of seeking, finding and forging stories and nothing but stories everywhere, at any cost.

This simple trick is played out by systematically overlooking and downplaying crucial formal differences between different modes of discourse - and by ignoring the most sophisticated theories of both narratives and games. [Sadly, similar ignorance and lack of knowledge of advanced narratologies informs and compromises also N. Katherine Hayles' otherwise ambitious attempt at telling her story of complex relations between mainstream print literature and science (and technology) in *How we became posthuman*]. While all this might sound trivial, the consequences of this operation are not: everything that is not sellable or re-definable as a story will be wilfully ignored.

When the safe and somehow manageable totality, be it coherent or not, vanishes from sight, the spectators and readers have to try different strategies of comprehension, which may seem complicated if and when they do not know the limits and the functional principles of whatever they are encountering in the disguise of an artwork. There's no guarantee that the work works as it seems to work, or continues to work as it has worked so far, not to mention that it works as its

manual or other paratext claims it works. Although the situation is usually far from being that extreme, these anamorphic and metamorphic works still contain fundamental and irreducible possibilities for unreliability undermining the illusions of mastery and control inherent to static scriptons.

If we adapt a standard deconstructive approach for a moment or two, we could show that there always already are both thematic and formal overflow overturning and shaking whatever our reading of a text tries to posit. In the case of narratology this means first of all that we should see the difference between narrative and textual designs. There's nothing exceptional in this; we can take any decent half-experimental 20th century fiction and show narrative organisation side by side with other, anti-, non-, or counter-narrative, organisations. Regarding films this is exactly the excess or the style that David Bordwell excludes from his clever film narratology. So, the excess is there even in the most banal Hollywood narrative, and there are various strategies of narrative comprehension reducing the importance of this excess. When Manovich applauds Peter Greenaway for inserting numerical lists into his films and installations to counter and resist narrative designs, Greenaway is doing exactly the same as countless fiction writers from James Joyce to Michel Butor and Milorad Pavic used to do decades ago. I'm sure Greenway knows these Dziga Vertov-like metaphorical "database" writers by heart, but for some reason Manovich doesn't – and this leads to an interesting series of serious misunderstandings on his part.

Computer games are very interesting, as they domesticate the excess of both ordinary and avant-garde products and the fundamental potential for change and unreliability inherent to new media objects. It would be tempting to generalise and argue that as long as we have systems where there are either one material level or several material levels with trivial mutual relations, narrative is the most powerful arrangement that can be used in them – but whenever the relation of levels turns out to be arbitrary the concepts of gaming and simulation will be more and more dominant. Despite the fact computers can support, emulate and modify whatever aesthetic tradition and convention there is, the most satisfying way of pacifying consumers facing potential insecurity will be computer games. But that's just idle speculation I'm not interested in continuing except by stating that we should have a closer look at this gaming contract also when designing other kinds of "interactive" or ergodic systems.

This closer look can be justified by the existing frame or paradigm of expectations among new media audiences. We can play with game-like structures and assumptions even when diverging from them. The other reason is precisely the concept of play; art audiences have faced this in various disguises and played with installations, video art, performances and telepresence projects, and they know they have to work and play to get cool or nice experiences out of aesthetic processes and products aimed at them; in short the mere contemplation is not enough any longer. What emerges is an interesting continuum from conventions to explicit, formal and binding rules, or a possible interplay of playing and gaming. This, on one hand, gives us a chance to see the traditions of experimental or avant-garde art from a somewhat different angle, and on the other hand they formulate another bridge to be crossed or burned: the one between interpretative art practices and configurative game practices.

First of all, games come with explicit rules that are shared by every player, they are not implicit or hidden; the strategy of an avant-garde artist is to conceal changes that he made to his version of a dominant code and convention and then wait for someone to decipher that in the fullness of time. I'm not arguing that these practices and assumptions should come to an end, but I'm not surprised to see that might already be the case. Within networked and programmable media it is so easy to make art that carries this hiding aspect to extremes, making the motivation for deciphering weaker, as it is more difficult to justify it or build a temptation strong enough.

There's yet another curious omission in *The Language of New Media*. Whenever Manovich takes up narrative issues and narrative theory he doesn't use film narratology at all. It is as if Bordwell, Branigan, Chatman and Thompson do not exist, or at least that whatever Manovich has to say about the subject is not tested and modified in relation to the most sophisticated theories of film narration there are. Even more curiously, various theories of non-narrative cinema are not even discussed in this context. There's one footnote referring to abstract animation, and no references to the parametric theories of Noel Burch. Instead we get a boring lecture about vanishing indexicality, and the metaphorical virtues of Dziga Vertov and his *Man with a movie camera* turning special effect into meanings, unlike the artists of more contemporary times. This nostalgic, uninventive and almost neurotic conclusion is not surprising, as it emerges from a fundamental misunderstanding of the book's subject matter. Whenever something cinematic encounters the pre-cinematic on a computer screen Manovich is oh so surprised, and sees new media as a platform for the re-emerging repressed be it loops or spatial montage. And then he puts himself in a loop between these two historical formations and seems to be very happy with this kind of conceptual compulsion to repeat. However, what he doesn't want to do would be the key to more intelligent and optimistic results. If computers are capable of emulating and supporting and combining every form in the history of visual representation, why should we privilege cinema – or painting or animation or cave drawings or installations or anything? In this Aarseth is clearly superior to Manovich. Aarseth is capable of situating every textual object from *I Ching* to MUDs in the same continuum based on how its medium

functions, but independently of what that medium is. That's also exactly what Manovich doesn't know how to do with his own material, although the idea would have been very easy to steal or borrow as it has been passing around for at least seven years before Manovich's book.

I think there's no historical inevitability in Manovich's monumental failure, which is ultimately based on his sentimental ties with cinema. Sadly, his book contains all kinds of ridiculous historical parallels and unfounded claims and explanations. My favourite example is the supplement of loops and spatial montage with linear feature films and their temporal sequencing. Manovich hallucinates a parallel to the rise of history and the decline of spatial imagination in the late 19th century Europe as explained or theorized by Edward Soja. However, as we all know from the history of painting there's a certain limit what can be told within one canvas, panel or screen. Quite simply, if you want to tell a long and winding story spatial montage is not enough, as there simply is no way of representing that amount of information simultaneously in pragmatically available and accessible space or place. Of course, this kind of explanation is not very useful if one needs to see cultural history as a cartoon or wishes to add depth to one's fashionable interpretations, but still it explains it all. What a pity.

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