KUNGL TEKNISKA HÖGSKOLAN
Royal Institute of Technology
Numerical Analysis and Computing Science

Extended Performances: Evaluation and Comparison

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Title: Extended Performances: Evaluation and Comparison Report number: CID-80

ISSN number: ISSN 1403-0721

Publication date: May 1998

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DELIVERABLE 2.3

Extended Performances: Evaluation and Comparison

Chapter 1

Chapter 4

Developing Electronic Arenas as Settings for Extended Performances: Nine Techno-Aestethic Challenges

Chapter 1

Introduction

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In the first year (actually 9 months) of the eRENA project, several extended performances have been conceived, developed and carried out within eRENA. In Deliverable 2.1 the *Cyberdance* experience from the University of Geneva and EPF Lausanne is reported. In Deliverable 2.2 the *Lightwork* and the *Mimoid* experience from Stockholm is described. We also draw upon documented experience from performances which predate eRENA or were principally developed in other contexts, namely *Video Only* by GMD and the *To the Unborn Gods* virtual reality opera at ZKM. While those works themselves were delivered elsewhere, the accounts and analysis of them (which, in the case of *To the Unborn Gods*, is extensive) are delivered for the first time here.

This Deliverable is concerned with the comparison and evaluation of the approaches to extended performance explored so far in the project. If the reader has already encountered Deliverable 2.1 and 2.2, it should be apparent that a considerable diversity of approaches to technology development and to aesthetic matters exists in the project. This jeopardises the informativeness of some strategies for comparison between them, as we seem to be on the borders of comparing unlike with unlike, perhaps being tempted to criticise chalk for not having some of the attributes of cheese. Indeed, as explained in the introduction to Deliverable 2.2, some artist-researchers within eRENA took the deliberate step of maximising the difference of their work to other approaches within the Workpackage to increase the project's coverage and internal diversity. The work of Task 2.3 (which Deliverable 2.2 reports on) was replanned accordingly.

This means, we feel, that the presentation of points of comparison between the five pieces available to the Workpackage in some tabular form (e.g. as if piece A had feature X, while piece B did not) would be misleading. The whole traditions which different works are situated in vary greatly. *Cyberdance*, for example, exists in a tradition of popular contemporary dance. *Mimoid* and *To the Unborn Gods* style themselves as opera. *Lightwork* is situated in an improvisatory tradition. Accordingly, rather than 'tabulate' points of comparison which could serve as dimensions for evaluation, we take the works together as charting the territory of eRENA's current work on electronic arenas as settings for extended performance, we characterise that coverage and ask whether it is broad enough, experimentally radical enough, and so forth. Ultimately, the concern of the eRENA project for ushering into existence new forms of performance environment (electronic arenas) is more encompassing than any particular work. Thus, the positive or negative evaluation of any particular work would be only partially relevant as the fate of the electronic arena concept is not tied to the fate of any single work. For these reasons, we end up in this Deliverable identifying key challenges for future work on the basis of

the experience available to us in Workpackage 2, rather than with some ordering of merit for existing work.

This comparative review is also contextualised by work conducted at ZKM reviewing the history of stage aesthetics. This reveals many fascinating similarities between contemporary performance practice and its problematic concerns and historically documented, though often forgotten, experiments at key moments in the development of technologies for the stage, for theatre and cinema. In this context, many of our contemporary fixations appear, as having a somewhat more extensive backdrop than contemporary self-proclaimed innovators would like to admit. In particular, this history reveals how pervasive questions of *staging* are, questions of the construction and manipulation of space and objects and bodies within it for dramatic effect, including the production of illusions. While many earlier experimentalists were plying their trade with analogue technologies, contemporary digital versions often share similar underlying problematics. These observations have greatly influenced the challenges that we identify for the development of electronic arenas suited for extended performance.

The Deliverable has also been influenced by the intensely practical and candid accounts we have of work conducted at the ZKM reporting on the production of *To the Unborn Gods* and, to a certain extent, the self-critical reflections contained in the accounts of *Lightwork* within the project (especially Deliverable 2.2). This work with its emphasis on the contingent and variable affair that is the work of artistic production makes for an interesting contrast with the rhetoric of many artist's statements and manifestos, which can give the impression that intentions can be realised effortlessly, or with retrospective reports of work done (but not adequately documented *while* it was being done) which are almost invariably celebratory. For one thing, artistic production becomes visible as an intensely and essentially collaborative enterprise, even under circumstances where only one or two artists are credited with the piece. Recognising the practical context for artistic work leads us to make a number of recommendations for future work. Most notably we entertain the idea that the manner in which such collaborations can take place could be just as much a matter for aesthetic scrutiny, criticism and design as the art works which comprise their outcomes.

This Deliverable is structured as follows. Chapter 2 (which contains two parts) presents ZKM's historical study of the aesthetics of staging performances followed by a detailed description of *To the Unborn Gods* together with reports of experience on some other, comparable opera-based multimedia works. Chapter 3 presents a brief retrospective on GMD's involvement with the 1995 *Video Only* distributed, mixed reality event. Chapter 4 closes the Deliverable with explicit comparisons between the different works available to the Workpackage structuring its remarks around nine 'techno-aesthetic' challenges for the future.

Chapter 2

Extended Performance Staging: Background and Evaluation

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Introduction

Image technologies calling on electronics and computers provide the performing arts with new registers of action. Theatre is characterised by the fact that it has always drawn its prodigious vitality from a mixture of organisms and objects, living and inert materials, shapes and energies. In many ways, the recent advent of electronic actors simply constitutes the latest extension of these possibilities, although these unfathomable creatures are eyed suspiciously by those who depict them as would-be usurpers of human actors, overlooking the fact that the latter have always been theatrically married to their simulacra.

The present paper is divided into two main chapters : the first briefly outlines certain historical developments in theatre aesthetics as a function of the role assumed by human actors with relation to their stage settings, and particularly with relation to various devices and technologies used to display images in the course of live dramatic action. Some recent experimentation conducted within the eRENA consortium is situated in this context. In particular, the chapter ends with Lawrence Wallen's and Thea Brejzek's reflection on non-interactive electronic media in contemporary music theatre, stemming notably from Wallen's computer-based artwork for three recent opera productions. This analysis pinpoints central issues raised by live performance with new image technologies, including many questions discussed in the subsequent review of the ZKM "Virtual Reality Opera", a work which employs interactive electronic media.

The second chapter presents an evaluation of this work. *To the Unborn Gods* is an opera by Japanese composer Kiyoshi Furukawa for singer, theremin, four instruments, and an interactive computer system with graphics by Robert Darroll, produced and performed at the ZKM in late 1997.

PART I :
Milestones in the History of Stage Aesthetics

1.1 Pictorial Stages

Since the first painted sets, said to have been created by Agatharcos of Samos for Aeschylus, we have been struggling to reconcile live actors and more or less figurative stage elements in a single space. Over the centuries, cloths, then solid sets and accessories have gradually become increasingly descriptive, and by the same token have gradually modified relations between the actor and the stage environment, to the extent that sometimes the role of the human actor would seem to simply consist of "being there", thus proving the viability of the depicted world. How we see and conceive the coexistence on stage of living flesh and figurative elements has varied hugely over time, and it is important to situate theatre spaces accommodating new technologies within this historic perspective. In so doing, we discover that the screen, which today jealously confines its electronic actors to an extremely limited space, is in fact comparable to the proscenium of the early Italian theatres.

At Palladio's Olympic Academy of Vicenzia (1585) and in subsequent proscenium arch stage constructions, the flesh-and-blood actor who idly strayed from the proscenium created highly problematic perceptual situations, since illusionist perspectives were obtained by carefully aligning sets of painted flats with gradually diminishing features to create an effect of distance. Such illusions were operative on condition that the human actor kept quite strictly to the thin strip of stage space allocated in front of this ingenious piece of visual engineering. Even in late 18th century European theatre, when changing aesthetic visions had begun to usher real three-dimensional objects onto the stage, dim lighting meant that it was still in the actors' best interests to stay close to the audience and footlights.

1.2 The Body Electric

Nineteenth century developments in lighting technology gradually opened up new possibilities in the creation of scenic realms inhabited by characters manifesting various degrees of presence or substance. Widespread adoption of gas toward 1820 was propitious to the ethereal hazes of romantic ballet, and also generated stronger shadows than previous oil and candle systems : creations such as the Pas de l'Ombre in Jules Perrot's ballet *Ondine* (1843), where the heroine performs a poignant dance with her own shadow, challenged and exploited the aesthetic potential of such advances. Mobile arc lamp projectors, first demonstrated by Foucault in 1842, triggered spectators' complaints of being blinded : a 6 ampere arc lamp is the equivalent to 320 lux, compared with only 14 lux for a gas lamp. The subsequent adoption of electricity was heralded by a plethora of stage extravaganzas in the latter half of the 19th century : an eccentric singer called "Miss Sita" illuminated Paris music-hall stages with the 150 incandescent lamps hidden in her

costume, that she could switch on and off as she pleased. In an 1893 production of Berlioz' *Damnation of Faust*, six sylphides were adorned with electric roses, and luminous fountains dramatically turned red or green at will. Many productions of this period featured rising suns and waning moons, which tirelessly chased each other across the stage. Electric swords were also all the rage (the sword blades would light up dramatically when they made contact), and ghostly spectra abounded.

One might have expected electric lighting breakthroughs, which finally made the stage practicable in all its volume, to signal the demise of the old trompe-l'oeil back cloths. On the contrary, painters were heavily solicited by the newly electrified theatres, and just like today's abusers of technological gadgets, many mediocre decorators proudly used the strongest projectors to flood their gigantic frescos. Painted grottoes, forests and palaces were standard settings for histrions, and indeed sometimes became their rivals : the set designers had no concern as to how their works would coexist with the human actors, and battles between painted and real shadows were frequent.

1.3   The Credibility of Full-Blown Stage Space

Towards the end of the century, the naturalist movement in theatre banned these illusionist sets and replaced them with solid 3D elements : walls and interiors, like outdoor settings, were no longer painted, but painstakingly constructed – moreover using materials that, as far as possible, were true to life (for a performance of Fernand Icres' play *Les Bouchers*, Antoine strung up real beef carcasses on stage, until the stench made this unbearable). Antoine and Zola in France, Stanislavsky in Russia, Edwin Wilkes Booth in America used a strictly realist yardstick to measure coherence of stage space : scale and depth were built rather than depicted, to make the box-set a thick, patently viable "slice of life". In this case, the problem of compatibility between the various representational registers operative in theatre was largely overridden : insofar as the stage world acted as a realistic duplicate for the real world, awkward mixes of live humans and painted environments no longer had to be dealt with.

The wilfully sought interpenetration and potential substitution of the real and stage worlds produced sometimes-paradoxical situations : for some of Stanislavsky's decors, dimensions of the unseen parts, in the wings, dramatically outstripped those of the actual visible stage sets. Moreover, the hidden parts of these "theatrical icebergs" were just as carefully and realistically wrought as the sections viewed by the audience, since credibility of his stage surroundings supposedly infused and aided the naturalist actor. Lighting, however, continued to plague the naturalists, in that they were working within a closed, architecturally contrived space which clearly required artificial illumination to serve its artistic purpose – namely, to offer spectacle.

1.4   Staging the Unreal

The swing against naturalism was essentially borne at the turn of the century by the symbolist movement, which vindicated the use of artifice, convention, and stylisation on stage, and the rehabilitation of theatre as a place of experiencing revelation, rather than as a place for acquiring critical insight into social condition. Performing arts were considered a unique vehicle for communicating strange visions that derive much of their poignancy and ambivalence from their real actor inhabitants. Maeterlinck's oneiric drama epitomises this cultivated unreality: for Lugne Poe's creation of *Pelleas et Mélissande* at the Theatre de l'Oeuvre, a gauze curtain veiling the stage gave it an ethereal quality, "dematerialising" the actors. Other frequently employed tactics to differentiate the unreal world of symbolist theatre from the vulgar quiddity of reality included the actors' adoption of hieratic gesture, and the use of heavily ornamental back-cloths; for Paul Fort's production of *Cantique des Cantiques*, music and colour were designed to fuse synesthetically in the incense-drenched theatre, while the action took place behind a translucent fabric with an unworldly metal sheen.

Early twentieth century avant-garde artists, seeking to convey new space-time constructs via the immediacy of theatre, called on lighting to atomise and freely rebuild stage imagery. In *Victory over the Sun* (1913), Malevich used powerful stroboscopic like effects obtainable with Luna Park theatre's then state-of-the-art console to create a "transrational" world of live colour and shape in constant flux. Malevich is one of many leading artists for whom the performing arts medium was a remarkable catalyst : suprematism according to the painter came into being as a result of his stage experience with *Victory over the Sun*. Giacomo Balla's *Fireworks* (1917), commissioned by Diaghilev, required minutely timed lighting transitions to animate its futurist dynamics at Rome's Teatro Costanzi (fortunately for pre-computer days, Stravinsky's score lasts only a few minutes). Fernand Léger's *Création du monde* (1923) for the Swedish Ballet was an optical magma of stark backdrops, mobile decors, and totemic dancers, which sprang to life thanks to the metamorphic energy of mobile lighting.

1.5   Projecting Pre-Recorded Images

Well before the invention of cinema, some of the most innovative late 19th century stage performances benefited from the projection of dynamic, textured effects using powerful lighting systems. Opera as a lavish form of spectacle tended to nurture avant-garde technologies : lighting engineer Hugo Bähr, who worked on many wagnerian productions, painted motifs on mica disks which he suspended and set in motion before the projector beams, to obtain vibrant atmospheric effects evocative of cloudy skies or foliage (like much late nineteenth century theatre technology, Bähr's work was well documented by *The Scientific American*). Adolphe Appia, one of the pioneers of twentieth century stage revolutions, foresaw theatrical use of cinematographic effects in 1895, declaring : "When serial electric photography is introduced onto the stage, projection will become all-powerful and few things will be able to resist it." (*La Mise en scène du drame wagnérien*).

In keeping with Appia's prediction, cinema technology was swiftly adopted by artists seeking to enrich the scope of live performance by injecting screened chunks of foreign space and time into the "here and now" of the stage. Cabaret and music hall were particularly keen to capitalise on the novelty of the cinematograph; in these popular theatre forms, it was quickly recognised that ambiguous situations where live and recorded images were indistinguishable had undeniable aesthetic and entertaining appeal. In a 1925 Paris journal, cinema critic Gustave Fréjaville mentions the magician Horace Goldin who masterfully juggled with a mixture of real and filmed objects at the Opéra Music-Hall des Champs-Elysées. Fréjaville also describes performances by Robert Quinault, classical choreographer and dancer, who composed a music-hall number where his live sequences were interspersed with slow-motion filmed versions of the same movements. Apart from the fact that this allowed the public to more finely perceive the dancer's virtuosity, use of film to introduce another quality of presence and motion beyond the usual human range created a singular type of spectacle, in many ways a forerunner of recent mixed media explorations.

Whereas Quinault incorporated filmed slow-motion sequences into his dances, other performers inspired by film worked on real-time slow-motion techniques: a couple of tap-dancers called "les Titos", and the Boganny Troupe's dwarf stars were virtuoso slow-motion buffoons. Vsevolod Meyerhold, in the Soviet Union, was profoundly influenced by cinema dynamics, which he explicitly sought to transpose to the stage, notably during his "biomechanics" period of the twenties. A few years later, Erwin Piscator's Berlin productions integrated complex projection devices for screening a wide variety of images, ranging from news footage to cartoons (e.g. *Hoppla, wir leben!* in 1927, *Die Abenteuer des braven Soldaten Schweyk*, 1928). Czech director Emil Burian invented his "theatregraph", combining slide and film projections, for a 1936 staging of *Spring's Awakening*. His compatriot Josef Svoboda took the 1958 Brussels World Fair by storm with the extremely versatile "polyscreen" technology that later became the hallmark of his Laterna Magika theatre.

1.6   Real-Time Audio-visual Projections and Electronic Actors

Since the sixties, video and sound-based technologies allowing instantaneous rather than deferred retransmission of analogue information have been rapidly taken up by the live art medium. During the "9 evenings theatre and engineering" organised in autumn of 1966 by Bell Telephone physicist Billy Klüver at the Sixty-ninth Regiment Armory in New York, artists who readily integrated these techniques in their performances included Robert Rauschenberg, Steve Paxton, Lucinda Childs, John Cage, Deborah Hay and Yvonne Rainer. Rauschenberg turned infrared cameras on the spectators to feature them in the performance site, thus dispelling differences between public and private arenas, between banal and aesthetically apprehended phenomena. Medical monitoring devices literally made a show of intimate body rhythms of certain performers. Over the past few decades, growing use has been made of directly recorded organic functions to regulate live action : often this has led to strangely solipsist dialogues between an actor/dancer and exteriorised functions of his own technologically mediated body. For example, in *Heartbeats*, a work

created by Christopher Janney in the early eighties, the dancer's cardiac rhythms were tracked and amplified to serve as a rhythmic basis for the choreography. Many performers have exploited this principle, including Robert Ashley and La La La Human Steps. Today, as artists begin to hook up electroencephalograms to CPUs to generate virtual environments, we seem to have reached a further stage in this exteriorisation/ spectacularisation process. As in the anechoic chamber, where John Cage in search of silence was astonished by the uproar of his own body, the human organism ostensibly reduced to its biological reality loudly emanates its primary rhythms, witnesses of passing time and proof of our mortality.

Complex interplay between actors and real-time images underlies rich stage experimentation in much recent work, including productions by Canadian Robert Lepage (*Elseneur*), American Peter Sellars (*Merchant of Venice*), and Italian Giorgio Barberio Corsetti (*Docteur Faustus*). The Wooster Group, which under Elizabeth Lecompte's direction has long excelled in extremely tight play between live and mediated images and sounds, has engendered many theatrical offspring in this same field. One of these, Marianne Weems, has produced a work called *Jump Cuts* which flits between footage from Murnau's *Faust* and filmed stage action that uncannily replicates scenes from the expressionist masterpiece. When the actors' meticulously predetermined positions yield filmed poses that belie what we actually see (for example, when players gazing into one another's eyes in the screen image are in fact back-to-back on stage), a disturbing theatrical quality is manifest, a quality that hovers somewhere in the limbo zone between the physical actors and their virtual counterparts.

Yet for all their scalar richness, their space-time acrobatics, their dissolution and inversion of the interior and the exterior, systems like those described above continue to comply with the ancient (ana)logic of the mirror image. The electronic audio and visual phantoms they generate are of the lineage of shadows and reflections - i.e. obedient, homothetic derivatives of their human sources.

1.7   Autonomous Electronic Inter-Actors

Modern image technologies tend to dematerialise acting bodies and their physical environments much as ancient projected shadow theatres used to do (that said, contemporary comparisons of shadow techniques with those of early cinema are reductionist, in that they overlook the widespread use of coloured forms and strong volumetric effects deployed in many shadow theatre traditions). However, the emerging spectra ex machina are singular in that they are no longer as enslaved to their flesh and blood actor-handlers as previously. Even video which is shot and shown in real time may undergo all kinds of transformations - colour changes, solarisation, geometric deformations, chromakeying, multiplication, etc. - which can be automated and perhaps doped with evolving functionality's, thereby to a certain extent made autonomous, giving digital characters a "will" of their own.

Motion capture historically derives from goniometric and potentiometric trackers originally used for orthopaedic monitoring; this history somewhat dovetails that of chronophotography, inaugurated by Marey and Muybridge one hundred years ago. But today's systems which digitally record moving bodies, yielding real mobile traces, are apt

to singularly extend the registers of presence live spectacle is made of. Research by Canadian computer scientist Tom Calvert has given rise to Thecla Schiphorst's software called *Life Forms*, widely used to choreographic ends (notably by Merce Cunningham) : although they are parameterised to comply with human biomechanical capabilities, the inhuman digital bodies that haunt *Life Forms* have a propensity for movements that do not "naturally" occur to a dancer's mind - or body. In this way, Schiphorst's digital dancers are radically extending choreographic syntax.

Motion capture data hybridised or "spiked" with other computer data (e.g. pre-existing graphic envelopes endowed with their own kinetic behaviours) can be programmed to pilot morphologies on screen that differ substantially from those of the human/s ensuring the initial movement input. Audio-visual creatures engendered by genetic and behavioural algorithms can literally evolve on screen; at the same time, the more sophisticated amongst them, interfaced with the appropriate sensors, can interact "intelligently" with humans on stage. Indeed, nascent technologies are profoundly altering the nature of tomorrow's phantom stage partners : future electronic inter-actors will be the products of artificial intelligence and behavioural animation, and biogame-type interactivity whereby virtual players steadily and continuously adapt to their human partners. MIRALab (Geneva) is conducting research along these lines within the eRENA group, as part of its attempts to generate "virtual humans" (see the University of Geneva publication on "Simulation of Virtual Dancers). Irrespective of the technical advances represented by such interaction between real dancers and their autonomous computer-generated counterparts, the question of how to build a convincing relationship between these two species on stage clearly has yet to be solved. Artistically interesting solutions no doubt require radical approaches to this integration issue, i.e. approaches that are not hinged on criteria of sheer life-likeness. Indeed, despite their value in the realm of realistic scientific visualisation, such criteria by no means constitute hard currency in the realm of theatre. On the contrary, questions of realism and verisimilitude have repeatedly acted as a stumbling block in the history of stage aesthetics.

1.8 Pending Holograms...

Today, exhuming illusionist techniques that date back, by and large, to the world of Robertson's phantasmagorias is making occasional forays into newly spatialised stagings. "Pepper's Ghost", a patented 1860s technique using mirrors to generate convincingly 3D phantoms, was recently employed by Canadians Michel Lemieux and Victor Pilon in their staging of *Grand hôtel des étrangers*; French dancer Kitsou Dubois' "*Zero Gravity*" choreography, inspired by her parabolic flight experience with the Centre National des Etudes Spatiales, likewise uses an old tilted mirror trick to create an image of dancers suspended in space. The use of smoke and laser beams to sculpt the environment, as in Hotel Pro Forma's recent *Orfeo* production, remains a fairly primitive solution, as neither the smoke nor the projected visuals can last long, and the range of patterning effects thus obtained is limited. The only systems which today seem to allow us to efficiently bypass the collective screen and its flattening effect, authorising electronic actors to appear with more convincing three-dimensionality, are individual head mounts, providing immersive, stereo vision. Yet these display systems isolate their wearers, setting up a solipsist mode of perception; this runs counter to the usual definition of theatre as a collective experience.

Pending major breakthroughs in hologram technology, alas, apparently still a long way off, actors contrived by analogue or digital images are at present condemned to the flatness of the screen. Moreover, despite considerable progress in the latest video projector technology, they generally have to stay shy of the footlights, most electronic images still being best viewed in relatively dark conditions. That said, the maximum visibility and brightness generally sought in "pure" projection circumstances (i.e. in a cinema-type-viewing situation) are not necessarily a goal in the live performance situation. Nevertheless, whatever the aesthetic options adopted with respect to the role and appearance of a screen, figures shown on its surface must be mastered and integrated into the aesthetics of stage performance, just as in the past, figures painted on canvas, sculpted in three dimensions, or projected by the play of lights, also had to be integrated into theatre aesthetics.

1.9 Use of Non-Interactive Electronic Media in Contemporary Music Theatre

The use of non-interactive electronic media in the live context of contemporary music theatre practice has constituted a strong focus for works by artist Lawrence Wallen, part of the ZKM eRENA team. Wallen's recent creations include media/stage designs for the Richard Strauss opera *Ariadne auf Naxos* (Opera Australia, Sydney, 1997), *Capriccio* (Landestheater Linz 1998), and *IOSIS Cross Media Opera* (Gesualdo et al), at the Eclat Festival for New Music, Stuttgart, in 1998. The conceptual phases and production periods of these stagings raised a number of questions central to eRENA reflection on extended performance, and in many ways constitute a useful transition point between the preceding historical overview, and the following evaluation of the "Virtual Reality Opera", an example of contemporary music theatre calling on interactive electronic media. Moreover, these questions may offer a useful methodological starting point for subsequent discussion of ongoing eRENA performance experiments with strong musical components, such as the *Mimoid* opera currently being designed for realisation in a CAVE environment by our Swedish partners (see corresponding paper by KTH within this same deliverable publication).

For Wallen and his collaborator Thea Brejzek, the use of non-interactive electronic media in contemporary music theatre raises major questions of a technical, dramaturgical and histrionic order. They have identified and formulated tentative responses to the questions they consider to be most recurrent, which are as follows :

- the status of the live performer with respect to staged electronic imagery

- the central importance of temporal structures deriving from musical rhythm

- the music/text relationship as the main dramaturgical backbone to opera

- the primarily manual workings of the stage (flying apparatus, follow spots and set changes being predominantly manually handled, etc.)

- the traditional use of built objects (sets, furniture) and of lighting to define the performer's location in a specific time or place (day/night; psychological states such as fear, joy, reality or dream state).

Concerning the issue of status of the live performer, electronic imagery generates a singular set of relations with the other stage elements, in that luminosity of projection or monitors on the stage by nature dominates a built set design (the quality of electronic luminosity often being described as "burning"). As the brightest light source within the theatrical space, this source constantly draws the audience's attention. Consequently, the performer's body is always seen as being "in relation to..." the size, content and brightness of the electronic image. Even if there is no overt interaction between the performer and the electronic image, communication between these elements is always inferred by the perceiving audience.

With respect to the question of musical rhythm, the use of pre-recorded, non-interactive electronic media poses the question of rhythm insofar as any process-bound imagery is subject to time/speed. Moreover, Western operatic tradition relies on audience ability to decipher and thus recognise emotional states through the musical interplay between text, rhythm and harmonics. The visual rhythm of electronic media results from the interplay between speed, brightness and content. In the case of pre-recorded imagery and live orchestral and vocal performance, the harmony or dissonance between musical and visual rhythm is crucial. Much of the overall "meaning" of a music theatre production involving electronic media relies on how the "question of rhythm" is handled. The ephemeral and fragile nature of live performance excludes per se even two identical performances of the same piece. Minimal rhythmic and tempo variations jeopardise the relationship between live performance and pre-recorded imagery if this aspect is not taken into account, first at the conceptual, then at the production phase. A combination of media, or a combination of pre-recorded and live-mixed sources may allow this disparity to be attenuated or overridden.

The advent of electronic media into the traditionally dichotomous relationship between music and text ("Prima la musica, dopo la parole", or "Prima la parole, dopo la musica", according to the Florentine dispute and its subsequent avatars), is such that the question of the rapport between music and (moving) image is taking on new importance. Depending on the musical nature of a work, i.e. the dominance of music over text as in a "bel canto" piece, the dominance of text over music as in a "recitativo" passage, the usage of words/ syllables/ as sounds or of the voice itself as an instrument as in contemporary compositions, the acting style, the "bodily dynamics", will be different and so will the visual treatment likewise differ. Thus, the relationship between orchestra/ voice, body and electronic image continues to constitute a core issue in contemporary music theatre.

Regarding the manually controlled stage machinery, the fact that much of the back stage working of a proscenium theatre / opera house relies on manual expertise should not be overlooked in the analysis of issues of electronic images and actors in live performance. Even with advances in computer-controlled lighting and hydraulics, there are always manual emergency procedures in place, and there is a tendency amongst theatre technicians to prefer manual solutions to computer-controlled solutions. The introduction of electronic media into the workings of a repertoire theatre or opera house invariably provokes questions of technological expertise, flexibility and teamwork within the technical department. Much of the success or failure of the use of electronic media within a repertoire company therefore depends on the quality of the dialogue between video artist and technical director.

Just as a carefully designed lighting plot defines the time and space occupied by the performer, so a carefully designed "media plot" opens up infinite possibilities of placing and defining the action of a piece or the psychological states of a single performer/ full

ensemble on the stage. The virtual, projected world of electronic media also allows the director/ designer to interpolate past and present, dream and reality in more complex ways than were obtainable with traditional methods (lighting, set changes). In most cases, however, the use of electronic media replaces neither set nor lighting designer; on the contrary, the video artist joins the existing creative team. Professional conflicts between the more traditional design roles of set and lighting designer and the more recent emergence of the video artist/ media designer in music theatre can readily arise because of lack of familiarity with the aims and concerns of one's professional partners. Ultimately, though, the question of the dominance of the electronic image over theatre lighting or sets needs to be confronted by all involved, given that the director's overall aim is essentially to integrate electronic media into the "Gesamtkunstwerk" of a music theatre production. Consequently, the search for ways to integrate electronic media into a built set and its workings, as well as into a narrative (in traditional pieces) or into a linear non-narrative construct (in new works), is an ongoing process for many artists working in the area of technologically extended performance.

PART II:
To the Unborn Gods, A "Virtual Reality Opera"

2.1 Inception / Conception

During the ZKM Multimediale 5, in October-November 1997, there were four performances of an music theatre work called *To the Unborn Gods*, by Japanese composer Kiyoshi Furukawa, for a singer, theremin, four instruments, and an interactive computer system using computer graphics by Robert Darroll. This creation constituted a milestone collaboration between the ZKM Institute for Music and Acoustics, directed by Johannes Goebel, and the Institute for Visual Media, directed by Jeffrey Shaw. The stage work provided the ZKM, and thus eRENA, with a unique opportunity for discussing possible uses of new media in the theatre, and was closely followed up and documented. In many respects, this "virtual reality opera" raises issues, which are central to eRENA extended performance preoccupations. Since there are few undertakings of this kind, offering a concrete basis for debate on the integration of computer graphics and interactive systems in live performance, we have attempted to elucidate some of these issues, and to set them in their context. Experience acquired from this theatre creation should thus serve as groundwork for constructive debate on the use of interactive technologies on stage.

"Our piece is a game in this sense: just as children play with colours and clay, we have played with new technology and mental images. "Of its own volition, the world is in the process is turning into a depot of machinery" (Flusser). Before one begins to investigate their meaning, it is important to play with these machines. Thought, feeling and critical observation begin in the game itself. Form and artistic expression emerge in this way.

In *To the Unborn Gods* interactive technology plays an important role in relation both to the acoustics and visuals. The scenic image is largely composed by the projection of a virtual world. What the singer sees on her passage through the virtual spaces is projected onto a screen behind her. The musicians can set in motion with their play (through pitch, loudness, etc.) the figures (virtual actors) who populate the virtual reality world. Due to its nostalgic, voice-like timbre, the theremin takes on the imaginary role of a second singer. The instrumentalists control the virtual instruments (real-time sound synthesis in the computer) or call up electronically edited noises and sounds. For me, interactive technology is a major expansion into new areas of the possibilities of instruments and human play."

Kiyoshi Furukawa

The following text is based on an interview with Heike Staff, from the ZKM Institute for Music and Acoustics, producer of *To the Unborn Gods*, and from information provided by Robert Darroll; quotes from the latter are from unpublished correspondence with the artist.

The work was commissioned approximately three-and-a-half years ago, as a short "music theatre scene", subsequent to a series of earlier pieces by Kyoshi Furukawa calling on interactive technology, and linking music with computer-generated images and animation. An important work in this direction is an interactive clarinet work called *Swim Swan* (1992-93), for which Furukawa developed the software at ZKM, in close collaboration with Pierre Dutilleux, a scientist expert in signal processing, responsible for live electronics at the Institute for Music and Acoustics. In this piece, the clarinet sound is analysed by computer, various parameters thus selected being used to control certain functions (to trigger electronic sounds, chaotic processes, etc). By the same means, the clarinet actuates and modulates a pre-recorded "Swim Swan" song; computer graphics patterns are likewise piloted by the instrument. Sections of the work are governed and

differentiated by specific sets of parameters, inducing distinct features and aesthetic qualities. Furukawa continued with this line of exploration in other pieces for singer and electronics, before commencing his latest "virtual opera" work.

From its inception, *To the Unborn Gods* was designed for a single singer/actor onstage with a small ensemble (namely clarinet, viola, guitar, keyboard and theremin), and for a computer graphics environment including virtual actor counterparts for the human actor. Furukawa sought to exploit the relationship between computer graphics and electronic music on the one hand, and flesh-and-blood presence and acoustic instruments on the other. The composer's prior experience in the field of instrumental works with interactive graphics was invaluable for this early conception phase, as he clearly knew which instruments most readily lend themselves to computer analysis and processing, and are thus most operative in the context of interactive systems. Being a musician, Furukawa wished the interactive elements of the piece to be essentially conveyed by its sound structure.

One can readily interpret *To the Unborn Gods* as being thematically caught up in a "realm of the in-between" : the central figure is a metamorphic character who navigates between roles that are themselves profoundly equivocal. Demeter navigates between life and death, the embryo is a kind of latent life, Sleeping Beauty hovers between life and deathly slumber. The entire work seems to be based on the notion of transitions and flux from one realm to the other. Perhaps the instrument which best exemplifies this state is the omnipresent theremin, this ancestor of electronic instruments which seems to technologically mirror the theme : with the theremin, strange gestures in the air produce sounds from another world, akin to both voice and instrument. The music as a whole tends to be little grounded in bass instruments and sounds; the singer's part was written for a lyric or even "girlish" voice, accentuating this notion of latency and in-betweenness. Furukawa deliberately sought a feeling of surface, a hovering, impalpable sense of detachment, for which his electronic music and Darroll's images would seem to be a particularly fitting vehicle. There is a poetic lightness and ethereal, fairytale quality to the work, in which VR technology functions like a kind of magic, causing miraculous transformations at the stroke of an electronic wand.
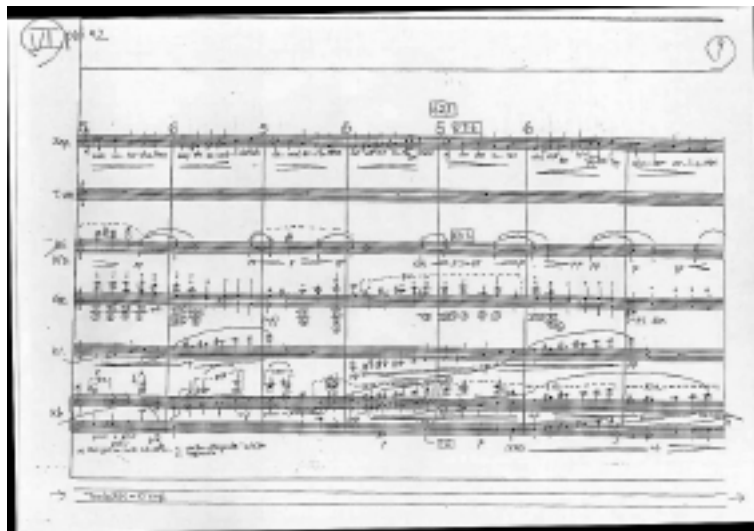
2.2 Transparency or Opacity of the Interactive Process

One of the central issues raised by an interactive sound piece like *To the Unborn Gods*, is the question of how to let the audience know that the musician (singer or instrumentalist) is in fact controlling the material of the work - in this case, the computer graphics component - rather than merely synchronising his/her art with the visuals, as in a standard playback situation. If the laws governing this control are made obvious, audience understanding and involvement is facilitated. This can be done quite simply, but without being painfully didactic, by integrating "explanatory" elements into the dramatic construction of the work. For example, a singer might make a certain gesture while looking at an adamantly unchanging screen, then a clear switch to another gesture might abruptly trigger a change in the visuals, to reveal the interactive process. In other words, simple events can be devised which elucidate the nature of the interactive relationship, while remaining an integral part of the dramaturgy. Perhaps there are lessons here to be learned from baroque theatre, with its stunning machinery-governed apparitions : surprise can be an effective, engaging emotion for a spectator, and the act of revealing and elucidating the processes that govern something initially mysterious can be a strong source of dramatic interest. For many contemporary artists, however, such tactics are unfortunately looked on as suspect or facile.

Furukawa did build certain sequences to perform this explanatory function. The question remains as to whether these were sufficiently explicit – and whether indeed they can ever be sufficiently explicit, without jeopardising the aesthetics of the work. To those who are wary of the trap of "demo aesthetics", and this fear is of course understandable, it should perhaps be pointed out that the fact that the work takes as its initial premise an interactive relationship governed by the musicians is already a strong conditioning, even determinant factor when writing the work. Consequently, the need to make underlying processes clearly understood is just one amongst many of the constraints inherent within creations of this kind.

This demand for elucidation of the processes underlying technology-bound works is not a transient need, as we await greater familiarity with new technological tools, but results from the extraordinary complexity of today's tools. The fact that any signals or parameters can be used to drive practically any other signals or parameters leads to an extremely open situation, where the artist's skill is intimately tied up in defining the rules whereby the former relate to the latter. Anybody can arbitrarily establish more-or-less operational rules to govern an interactive process, but their manifestations, the relationships they set up, and the types of response that they trigger, swiftly become so complex that they obscure the initial underlying principle. This complexity is inherent to digital processing tools. The artist's essential task thus consists of defining the rules which govern the connection between the two sets of parameters or signals and, in creating these rules, to decide whether and to what extent they should be evident, as the crux of the interactive relationship, and as the source of aesthetic experience.

2.3 Audible Versus Visible Interactivity

Another, perhaps more important issue to be raised with respect to this virtual opera concerns the radically different levels of aesthetic apprehension of a work like this for an audience with a strong musical, as opposed to visual background. We are living in a culture that is dominated by visual references, and this dominance may be prejudicial for artists working with more complex sound structures, as in the case of Furukawa. Ironically, he is a twofold victim of the misconceptions of his "oculocentric" audience : when the relationship between the singer and computer graphics is made quite visible, as in the "Ring around the Roses" nursery rhyme scene, where the instruments obviously govern movement of the virtual actors (Darroll's computer graphics figures), people wise to playback techniques query the authenticity of this apparent interaction. As Darroll says "The point of musical interactivity could be fun for the musicians, but from the perspective of a viewer, they could just as well be playing synchronised to a predetermined action as in a film (...) and there is a curious inversion of reality where actions generally cause sounds and not vice versa." But curious inversions of reality are sometimes in themselves a source of powerful theatricality. Furthermore, however justified Darroll's criticism may be, it is, avowedly formulated from the perspective of the viewer as opposed to the auditor (this debate is oddly reminiscent of an early nineteenth century polemic in England, when Drury Lane and Covent Garden, rebuilt to accommodate more spectacular forms, were denounced by their adversaries as "theatres for spectators rather than playhouses for hearers").

To the Unborn Gods contains many moments where attentive listeners can easily follow the control of certain sound elements by other audio material - for example, in an early passage of, the guitar audibly governs a spoken commentary -, but this interactive relationship, which is quite obvious for someone versed in contemporary music, sadly tends to elude the more visually oriented public. In the latter instance, failure to recognise the interactivity ruling the sound elements severely compromises many people's understanding of the performance : whereas music-goers are tuned to subtle interactive processes from the beginning of the work, those who fail to pick up these cues see the

interactive aspects as being somewhat paltry and gratuitous, since they only recognise them in the more patently interactive visual processes.

2.4 Interactivity and the Extended Instrument

Live electronics has a long history in the musical world, and is founded in the concept of the extended instrument; current investigation into interactive music is simply a further development of this concept. In aesthetic terms, this means that a standard instrument, for example a guitar, can be endowed with dramatically extended possibilities : it no longer merely yields sound when the chords are strummed, but can be made to speak texts, to pilot visual material, and to indeed to perform any function governed by signal input, i.e. innumerable functions which do not arise from the intrinsic properties of an acoustic instrument. The autonomous instrument thus becomes something else, something much larger. By the same token, the small ensemble becomes an orchestra, and can in turn conjure up visual elements that would not normally be associated with a musical instrument.

This notion of the extended instrument subtends all of Furukawa's work, including *To the Unborn Gods*, which has to be understood first and foremost as an extended musical environment whose interactive features intimately depend on sound. Yet opera places us in a theatre, as opposed to a concert situation, where visual and dramatic elements independent of strictly musical aesthetics must be dealt with.

2.5 The Computer Graphics Material

The visual material created for *To the Unborn Gods* cannot be dissociated from its dramatic construction, built around a constantly changing figure enacted by the singer. From Demeter to the embryo, from the Sleeping Beauty to Jonas in the belly of the whale, the central figure undergoes a series of metamorphoses that carry the dramatic line. This succession of "avatars" is clearly characterised by the lyrics, by the intonation, and by changes in apparel : the singer's character transitions are indicated by her doffing and donning a series of head-dresses. Moreover, each role has its own specific setting; coloured projectors light the blank screen for the opening scene, a complex textured background derived from multiple image sources locates the "embryo" scene, etc.

Interactive computer graphics are displayed during two of the six scenes, i.e. approximately fifteen minutes of a work that lasts about forty minutes. In these scenes, the audience is supposed to see what the Sleeping Beauty sees, as she explores the palace labyrinth world : virtual camera movements within the computer environment track the singer's movements on stage, leading us through the labyrinth. This effect is obtained by having an operator at the control deck, located at the rear of the auditorium, move a cursor through the graphic world, carefully co-ordinating this trajectory to match the singer's movements. Initial proposals to actually fit the singer with a tracking system were quickly abandoned, since in this case she would have had to constantly watch the screen to control the movements – thereby turning her back on the audience. Darroll considers that the animation software was too stilted and limited to engender interesting interactive sequences (it allowed simple spline movements, which were moreover unstable and very

difficult to control), and feels that too much time was spent developing and waiting on new software which ultimately remained seriously limited in terms of its theatrical applicability.

Size of the computer graphics database prohibited work with available tools for a prolonged period, so that the interactive software only really became available a few months before the performance. Today, the processing capacity limits that blocked work just a couple of years ago seem laughable : current machines are more than adequate for what was then being attempted. But one must produce for the available tools and resources : an artistic project has its own coherence and cohesion, irrespective of what generation of processors it implements.

Darroll, an experimental film-maker familiar with digital tools, expected most of the major artistic decisions to be made well upstream in the production process, as usually occurs in the film industry. Since this was not the case, he proceeded in keeping with film-maker's logic, and designed a fairly firmly established story-board. This way, Darroll and computer graphics artist Tamas Waliczky, assisted by Christina Zartmann, moved steadily ahead with a visual scenario, whereas the director was unprepared to make certain decisive artistic decisions until much later, i.e. at the actual rehearsals. The computer graphics team felt it necessary to forge ahead on a story-board basis in order to deal with their fairly complex graphic tasks (the building of coherent spaces representing palaces, corridors, labyrinths, and of the various virtual actors that had to dance, jump, fall apart, etc). A major computer graphics production is a lengthy undertaking, and its realisation complies with a different kind of time scale to the rehearsal period of a theatre production. Yet the rehearsal period for *To the Unborn Gods*, along with many major artistic decisions, were constantly deferred, pending technological progress with the interactive interfaces.

This led to the conflicts that invariably arise if artists used to working in a specific field – film, graphics, sound – embark in isolation on work for a collective production in a medium which is largely foreign to them, namely live performance. There is an infinite difference between screen and stage space, between theatre and concert space, and all these media are governed by their own rules, which have to be respected. Without initial clear definition and common recognition of the basic artistic premises that govern a work, and that are strong enough to ensure cohesion of the various elements, there is little chance of achieving satisfactory integration in a theatre work.
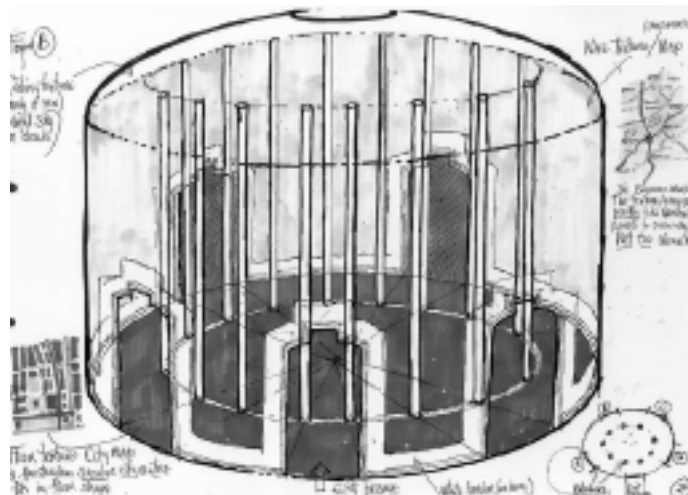
2.6 The 2D-3D Screen-Stage Gap

The old issue of reconciling screen and full-bodied stage images re-emerged quite acutely in this production, the more so in that the ZKM Medientheater stage is an extremely small space, without wings, more akin to a screening room than to a theatre space. Darroll's original plan was to "extend the real stage space into a Virtual Reality by means of a projected image on a screen behind the stage. The real stage and the virtual stage were to be coupled by a high degree of interactivity between musicians and actors on stage and figures and actions in the VR. The VR projection was not envisaged as a kind of window behind the stage, but as an extension of the stage. In the original designs, the screen was to be visually integrated into the form of the stage. The rectangular form of the screen was to have been broken into a rectangular form (by masking), which should have been continued from the vertical into the horizontal of the stage via a series of steps. The Stage was to have been stepped so that the singer could act partially in front of the projected image but below the projection beam."

As it turned out, and to quote Darroll once more, "the screen was positioned above the actual state, with no visual clues to promote the inter-relatedness of the two spaces." In fact, the screen emplacement produced the impression of a cinema-type projection running as background for the singer, with little ostensible relationship between the two. It should be pointed out that, in addition to technical constraints inherent to the virtual reality opera, it constituted part of a programme comprised of three short works, and scene changes had to be kept to a strict minimum to reduce intervals between these music theatre pieces. Furthermore, the Medientheater is not equipped with a back projection system, and frontal videoprojection, even with the most powerful projectors, remains chronically sensitive to ambient light. This frequently encountered problem ruled out many simpler solutions which might otherwise have succeeded in attenuating the gap between the screen and stage space.

2.7   Technical Set-up
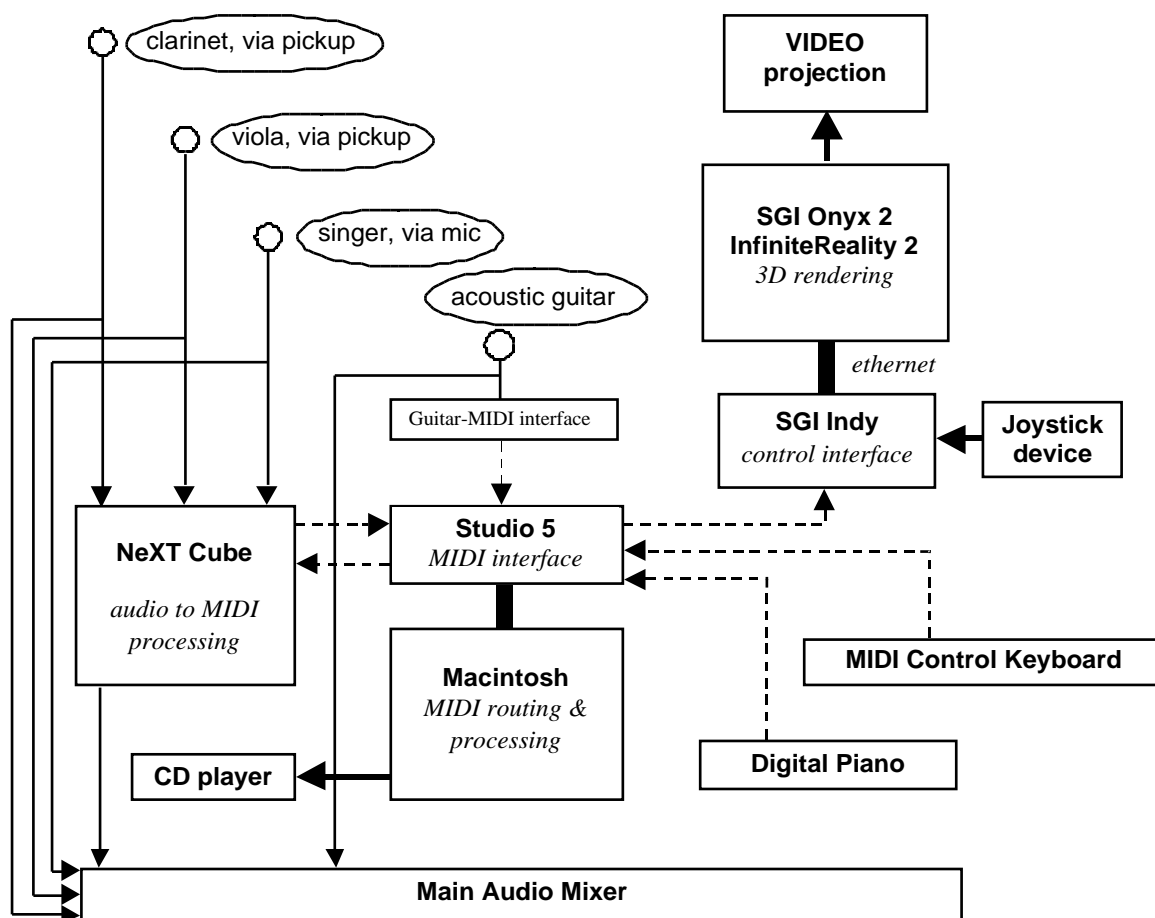
In the diagram the main components of the technical setup are shown. The NeXT computer is equipped with ISPW signal processing cards and is used for signal-to-MIDI processing of the incoming analogue audio signals that come from the traditional instruments and the singer's microphone. The NeXT is also used for producing a real-time physical modelling sound synthesis of bell-like sounds, which are triggered and controlled by the clarinet and the viola.

The MIDI signals coming from the NeXT, a MIDI digital piano and a pitch-to-MIDI interface (which converts the audio signals from an acoustic guitar) are fed into the MAX MIDI processing software which runs on a MAC computer with a connected Studio 5 MIDI interface.

The MAX program is responsible for processing and re-routing the different MIDI input messages on to specific destination devices, namely the Silicon Graphics O2, an audio sampler (not shown in the diagram) and a controllable CD-player (connected via serial interface to the MAC). For each of the approximately 30 scenes of the opera, a completely different MAX set-up is loaded. The set-up switching is triggered from a second MIDI keyboard by the keyboard player and can hence be (manually) synchronised with the conductors directives. Both, the sampler and the CD-player are triggered by the instruments and the singer's voice to play pre-recorded narrations and special effect sounds. Of course, the specific context changes for every different scene.

MAX also sends scene switching messages to the O2, which runs a user interface program for controlling the actual 3D scene display, which is done by an InfiniteReality2

high-end graphics workstation. Also connected to the O2 is a two-joystick control device which is used for manually controlling the camera in the 3D virtual scene. The video output is projected on a large screen at the back of the stage.

All the audio signals coming from the traditional instruments, the microphone, the acoustic guitar, the NeXT, the CD-player, the sampler and the piano are fed into the main audio mixer.

2.8 Virtual Scene Control

The virtual scene consists of a static scene description file containing all 3D objects along with their material and texture definitions and their default positions in the scene. Additionally all object animations, their triggering by MIDI messages and the default virtual camera path are described by a general purpose script language.

The static scene was modelled and edited with a modelling tool which allows special optimization of the scene structure for real-time display with the SGI Performer-based display application running on the InfiniteReality workstation (SGI Performer is a special API developed by Silicon Graphics for 3D graphics real-time applications, to exploit their high-end, multi-processor, multi-graphics-pipeline workstations easily).

The basis for defining and editing the virtual scene animation script is a graphical user interface called TKPF. TKPF was developed using Tcl/Tk and basically implements a Performer rendering pipe and an editing widget for writing and testing the scene script. For practical reasons it is possible to display the editor and the rendering output on different machines.

The editor integrates an interpreter for the scripting language LUA (see www.tecgraf.puc-rio.br/lua/). All animations are described as LUA programs and combine the techniques of standard keyframe animation (through Hermite splines) and procedural animation. The editor provides a text editing widget for editing and immediate testing of the animation scripts as well as a simple spline editor used for creating pre-defined motion paths and animation function curves for the scene objects. LUA is a very fast and easily extensible interpreted language and was therefore used instead of Tcl, which might have been the obvious choice.

To be able to control the Performer rendering pipe, LUA was extended by a set of Performer function bindings. These bindings where created automatically by a Perl script, which simple parses the original Performer C header files and outputs a C program which exactly defines the needed LUA extensions. When linked with these newly created library, the Performer functions are available for use in the animation script and can be used to control and modify the objects in the Performer scene tree. Additional extensions were made for accessing the MIDI interface and for handling the input of the joystick device.

```
function backdooropen(t)
  if t>=6 then
    pfdcsrot(O_lbackdoor,0,0,0);pfdcsrot(O_rbackdoor,0,0,0)
    deactivate(backdooropen)
  elseif t>=4 then
```

```
    h=90-(t-4)*45
    pfdcsrot(O_lbackdoor,-h,0,0);pfdcsrot(O_rbackdoor,h,0,0)
  end
end

function palace_sleep(t)
  pfdcsscalexyz(O_p1,1,1+0.7*sin(120*t),1)
  pfdcsscalexyz(O_p2,1,1+0.7*sin(300*t),1)
  pfdcsscalexyz(O_p3,1,1+0.7*sin(180*t),1)
  pfdcsscalexyz(O_p4,1,1+0.7*sin(240*t),1)
  pfdcsscalexyz(O_p5,1,1+0.7*sin(280*t),1)
  pfdcsscalexyz(O_p6,1,1+0.7*sin(220*t),1)
end
```
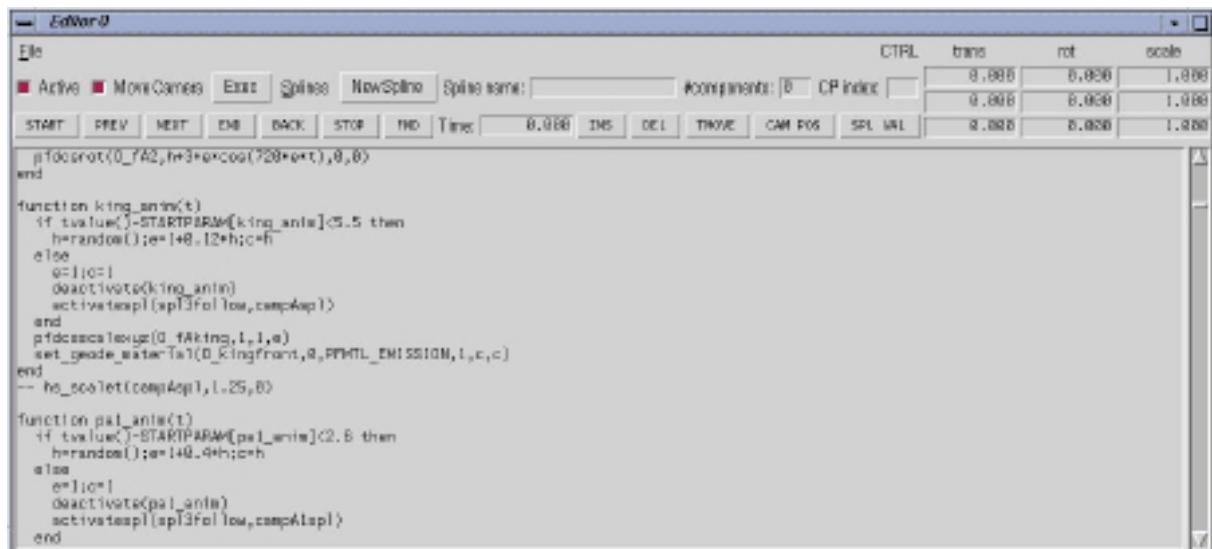
The above example shows two animation functions written in LUA, the first is used to control the animation of opening a door (mainly a rotation of a door object over time), the second one is used to animate the size of a couple of objects to give the impression of breathing/sleeping (all Performer related functions start with pf).

The above image shows a snapshot of the script editor and animation control interface. The controls for starting and stopping the script and the interface for the rather primitive spline editor are visible. Spline creation is not very comfortable and is done by entering time/value pairs for a new control point. A name is assigned to each spline which then can be referenced later in the script and be used for creating time dependent interpolations.

The virtual camera path in the opera script is also basically controlled by a spline path. For additional, external control it is possible to let the external joystick take over the control over the point of interest of the virtual camera and also to make slight corrections to the current position of the camera. It is thus possible to change the perspective manually according to the behaviour of the singer/actor.

2.9   New Collaborative Structures for Experimentation

With hindsight, it is easy to say that a director should make clear decisions well ahead of the rehearsal period, that a visual artist involved in a theatre production should not be

proceeding on the basis of a story-board, and that a composer should have written a substantial part of a work before seeing any images. But the real lessons to be learned from this experience are more far-reaching : for productions of this kind, anchored in radically new tools and processes, traditional professional collaborative structures are no longer valid. New structures must be developed. It is not sufficient to bring together contemporary artists familiar with new media (though not necessarily with theatre), and other artists familiar with modern music theatre, in the hope that they will create something original if provided with new tools.

In this particular case, the work structure partially derived from the old system – stage director, composer, and visual designer. Yet what is really needed in a truly experimental undertaking is one or two artistically pivotal people with theatre experience, who can make the crucial decisions. A multidisciplinary team can then be built around this core. Traditional theatre collaborations have been surpassed by technological developments, and novel kinds of structures are needed for truly experimental works. The new working situation requires new areas of competence, a complete redistribution of responsibilities. An important category of persons effectively involved in new collaborative art experiments are the go-betweens, i.e. people who have a synthetic vision of the work in progress, and at the same time keep sight of the final aesthetic goal; these persons can act as a precious link between the various actors, as translators and mediators who sustain and consolidate the collaborative work.

Conclusions

We are dealing with technological tools that have a powerful shaping effect on art, and that necessitate collaboration with technical and scientific specialists; it is vital for these people to be able to communicate closely and freely with their artist co-workers, to identify and elucidate the real technical constraints and liberties, so that these are constructively taken into account during the creative process. As far as the artists' technical culture is concerned, this must be sufficient for them to grasp the conceptual implications of the technology being used, and thereafter to deduce the aesthetic meaning of these implications. Any concept is the bearer of meaning, and technical concepts are no exception to this rule. Artists who have not understood this have no reason for working with technological tools. Often, the aesthetic meaning that underpins technologies is not immediately apparent, and free, open investigation is necessary to identify and exploit their artistic implications. In particular, artists must be sufficiently familiar with the technologies they are using to know how much margin for change these withhold : many aesthetic problems arise when artists have underestimated the obduracy and the rigidity of the tools and processes they have chosen to use.

The ZKM virtual reality opera, *To the Unborn Gods*, remains a unique experiment in the use of interactive technologies on stage. It sheds precious new light on interactivity issues, in that preoccupations from the musical world in some respects diverge from those more commonly discussed, that arise within the world of computer graphics. The long history of electronic instruments, which embody an intricate blend of technology and aesthetics, has much to teach the younger world of computer graphics. But the still longer history of performing arts has much to teach both these fields, and theatre indeed offers a rare opportunity for their convergence.

Appendix

To the Unborn Gods

Concept and composition: Kiyoshi Furukawa

Design of VR , computer graphics and first costume sketches: Robert Darroll

Text selection: Kiyoshi Furukawa and Henry Akina

Music technology: Kiyoshi Furukawa and Pierre Dutilleux.

Image technology : VR realisation : Tamás Waliczky.

Assistant: Christina Zartmann

VR Programming : Adolf Mathias

Project management: Heike Staff

Commissioned and produced by ZKM. Made in the studios of the ZKM-Institute for Music and Acoustics and the ZKM-Institute for Visual Media, 1994-1997

First performance on 31.10.1997 in the ZKM Medientheater

Musical director: Zsolt Nagy

Stage Director: Henry Akina

Stage design: Stephan Besson

Costumes: Katrin Kath

Masks: Mareile Fritzsche

Lighting design: Rolf Derrer

Sound design: Christian Venghaus

Singer: Julia Henning

Theremin: Lydia Kavina

Viola: Ulrich Ziegler

Clarinet: Gershon Dembrinski

Guitar: Andres Hernandez

Keyboards: Benjamin Kobler

Live electronics: Pierre Dutilleux

Audio Technology: Torsten Belschner

VR Technology: Adolf Mathias

Technical Direction: Stephan Besson

Stage manager: Anja Winkler

Producer: Heike Staff

Chapter 3

The *Video Only* Trial: A Brief Description

The *Video Only* trial explored the potential and suitability of the Virtual Studio and Distributed Video Production (DVP) technology for new artistic concepts in extended performance. The only possible way for such an experiment was to embedd it into an existing research scheme concerned with technological development of DVP because the European Commission has been promoting its technical development as part of the ACTS programme. Unfortunately, however, there is no funding for developing flexible software geared to the needs of audience and performers. There is almost no support for the design and construction of virtual scenarios or for drama productions with their costly rehearsals. The broadcast covering the award of the 1995 Video Art Prize (10) could therefore only be realised through a technically oriented GMD research project (Distributed Video Production). For the first time ever, the Virtual Studio at GMD therefore undertook a collaboration between dance and stage which took place at two different locations. The virtual sets were transmitted live from Bonn via an ATM broadband to the studio stage in Baden-Baden.

Concept

Few Virtual Studio productions can lay claim to an image language that is adequate for the medium. In most cases, the individual image layers are not interwoven and presenters react dispassionately in the empty blue room. If they are indeed able to react to their visual environment and disappear through virtual doors, then they only succeed in doing so when working with a highly specialised team. The presenter is merely a puppet in this game. Be that as it may, the empty room is the interesting aspect in this scenario. To ensure that the actors do not get lost in this blue room, they must commit the scene to memory. They must really act and not just go through the motions. The emptiness is a challenge to their imagination, to a spatial mode of thinking and to reaffirming the body's gestures in space.

On 19 November 1995, some 150 invited guests in the Baden-Baden studio find themselves in front of and actually inside the virtual sets transmitted along data lines the some 350 km from Bonn to the SüdWestFunk (SWF) studio. Two cameras, numerous actors and the audience are in blue box of the SWF TV studio, though the virtual sets themselves are actually in GMD's digital studio. The broadband network of Deutsche Telekom is used to transmit the camera shots of the actors to Bonn where they are inserted into the virtual sets and, without any noticeable delay, are retransmitted to Baden-Baden. For the first time ever, a blue box is used live as a stage. Eight virtual stage sets with their metamorphic build are used to give structure to the chronological sequence of events. The audience in the studio sees the actors in the virtual sets on the wall-high projection area - the "apparent" image that will be used later for the TV transmission - while the presenter and dancers live in the studio perform against the empty blue stage. As in the theatre, the

performers appear from backstage. But here the voices appear from behind the audience's backs. The presenter appears in the image on the video wall. The scene of the action changes and also takes in the space occupied by the audience. The dancers leave the real stage through the audience area and apparently disappear in the video wall. The studio guests' attention is pulled to and fro. Part of the dramatic effect of the transmission is created by the fact that the audience are seated in swivel chairs, and thus create a similar picture to the movements of spectators on a tennis court. The game with reality remains the most important theme when working with virtual sets.

Technical Realisation

Live camera tracking from the recording site - a blue room studio in Baden-Baden - was sent to GMD in St. Augustin more than 300 km away. The television signal and the virtual scenario were rendered in sync with the remote camera motion and sent back to SWF over an ATM connection. In addition, to compare performance and quality, a second camera was connected to a local virtual studio system. Technically, the *Video Only* trial successfully demonstrated the viability of remote rendering of a virtual studio via ATM.
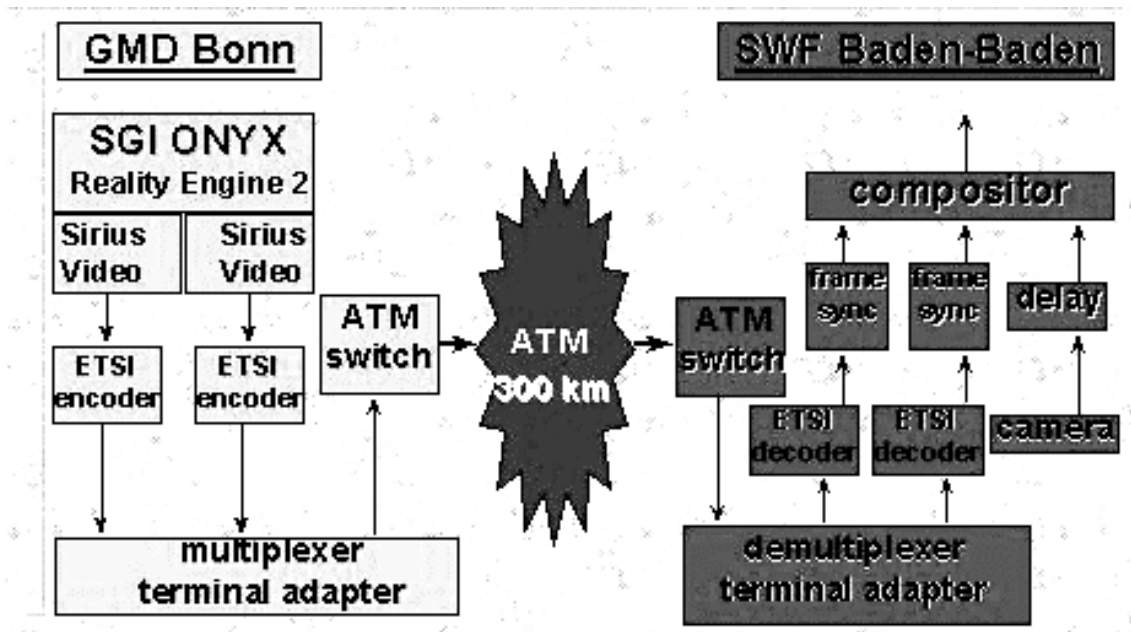
Chapter 4

Developing Electronic Arenas as Settings for Extended Performance:
Nine Techno-Aesthetic Challenges

John Bowers
Centre for User-Oriented IT-Design (CID)
Department of Numerical Analysis and Computer Science (NADA)
Royal Institute of Technology (KTH), Stockholm, Sweden.

Introduction

This chapter is concerned with explicit comparison between the approaches to extended performance which have been made available within Workpackage 2 in the first year of eRENA. Our treatment comprises a review and discussion of the following works: *Cyberdance* (as reported in Deliverable 2.1), *Lightwork* and *Mimoid* (as reported in Deliverable 2.2), *To the Unborn Gods* (as discussed in Chapter 2 of this Deliverable) and *Video Only* (as briefly described in Chapter 3 of this Deliverable). The first three of these pieces are delivered to eRENA and have been developed to their current state during the first year of the project. *To the Unborn Gods* and *Video Only* predate eRENA in various ways, though the accounts of their development presented in this Deliverable are new here. This set of works, though of course a minute sampling of what is available in the domain of electronically and computationally extended performance, manifest some quite large differences between them nevertheless. These differences can be felt both aesthetically and technically. As such, we have taken the step in this Chapter to confine our attention to them and to use comparisons between them to lever major research challenges which, we believe, are of relevance beyond just these five work and, indeed, reach beyond the exclusive domain of extended performance into, for example, rearticulations of how research on Human Computer Interaction (HCI) in general might be carried out.

It should be emphasised again (cf. Chapter 1) that we are not here attempting a point by point aesthetic evaluation. This is not a work of art criticism. This is not because the author is without positions he would wish to argue for and criticisms he would make if writing in that mode. After all, he is one of the authors of one of the works and could hardly be said to be innocent in this regard! Rather, the purpose of the current document is to appraise the current state of *the project's* work on extended performance and, through this, to identify key challenges for future work. Individual works are not singled out for critical appraisal. Rather, the coverage of the project through these works is what is discussed. It will be seen in what follows that a number of challenges are laid down and, in places, a few calls for more radical experimentation are issued.

These challenges are articulated under nine headings:

- staging: spaces

- audiences

- performers

- interaction as a public phenomenon

- devices for performance

- intermedia mappings

- narratives

- collaborations and other practical affairs

- traditions.

Each of these are intended to relate to the specifics of performance, rather than concern topics in interactive art or technology in general. That is, we focus on the spaces in which performances are staged, the relations between performers and audience, the nature of interaction and interaction devices in the public setting that a performance comprises and so forth as constitutive features of what normally counts as a performance, rather than say the experience of an interactive work in a gallery or installation setting or via broadcast technologies (more properly the concern of Workpackages 1 and 3 respectively). Questions of relations between media, narrative, collaboration and tradition are more general but we shall again focus on the specifics of these matters as they are encountered in performance settings. Throughout, our focus is on the challenges that will need to be met to develop an 'electronic arena' as a setting for extended performance. However, this specific focus does not mean that our arguments are without implication for 'inhabited TV' or 'extended galleries'. Indeed, we point to a number of possible sites of confluence between these different kinds of electronic arena.

In assembling these challenges, we have found technical and aesthetic concerns to be interrelated quite closely. This is not to say that some form of technological determinism exists whereby forms of aesthetic expression are determined by or always strongly constrained by available technology. Nor are we arguing that technical development should enslave itself to artistic 'requirements'. Both art and technology worlds have a life and a trajectory of their own (indeed multiple trajectories). We are also not suggesting that it is impossible to separate technical-computing questions from aesthetic-artistic ones. Most of the time this is non-problematic. Few professional software engineers would regard themselves as artists and vice versa, and a training in one is not regarded by practicioners as interchangeable with a training in the other! This Chapter is not predicated on the assumption that art and technology are or should be so interwoven that traditional distinctions fall away, so that everyone must become an artist-technologist and that all our conceptualisations should become monistic. Rather, we are saying that *in practice,* in the production of an art work, in the practical work involved in assembling a performance, artistic and technical matters commonly intertwine in such a way that any set of practical challenges is likely to be hybrid. Accordingly, we refer to our challenges as being 'techno-aesthetic' not because we regard the boundaries between these forms of life as having dissolved in recent supposedly postmodern times but because each of the challenges has both aspects and, we believe, will be intelligible to both communities.

Let us begin.

Staging: Spaces

What are the spaces that can be identified in the staging of the extended performance? We are here referring to the real, physical and the virtual spaces which constitute the setting for the performers and/or the audience's actions. Four kinds of space are commonplace in performance settings.

(1) Backstage and 'in the wings'. These spaces may be exploited to hide the mechanisms which makes the performance possible whether those 'mechanism' be computing machinery or scenery lifts and hoists. What is done backstage or in the wings is critical in traditional theatre performance for securing whatever illusions are being created in the work. No backstage, no discrete, hidden space, no illusion. Backstage and the wings can also be transitional spaces for performers. One might enter from backstage and come to frontstage. One might wait in the wings for the cue which enables one's entrance to be made. Though part and parcel of quite traditional theatrical techniques, as Chapter 2 points out, similar uses of space are quite commonly found in contemporary work otherwise deemed more radical or experimental. In *Video Only* the performers appear from backstage. In *Lightwork* projection equipment is hidden backstage (or at least behind the screen). Dancers makes their entries and exits in a traditional fashion in the *Cyberdance*. In *To the Unborn Gods*, the entry and exit of the singer are made through the audience as no wings exist.

(2) The stage space. Several of the pieces developed within this Workpackage also avail themselves of a stage space which comprises the space of action for the human, real, embodied performers and the devices they interact with along with any other props. In *Cyberdance*, the stage space is the setting for the dance. In *To the Unborn Gods*, an inclined stage space is used partly to compensate for the flat seating floor in the ZKM's Medientheatre but also partly as a residue of ideas for blending stage space and projection space which are described in Chapter 2. In *Video Only* a precisely calibrated stage space is used so that blue screen style projections and the interactions across real/virtual boundaries that they permit can be synchronised and aligned. As Chapter 2 of this Deliverable reveals, such constraints on performer latitude for action have been necessary ever since theatrical illusions were innovated. *Lightwork* takes a somewhat different approach. Rather than carefully light the performers or the stage space so as to focus attention upon them (as exists in the other cases discussed—up to the limits permitted by the projection technologies used), it is the projection itself which is the main source of light. Performers, deliberately, appear as rather shadowy creatures in front of the projected virtual environment. In this way, phenomenologically, the stage space becomes narrowed and the staging becomes more cinematic.

(3) The projection space. In the set of works we address here, video (commonly portraying virtual realities of various sorts) is projected typically to the rear of the stage space. In *Video Only*, flat stage, side and rear wall spaces are blue screened though a stage is reconstituted in video. *Video Only* is perhaps the most extreme of our examples of illusory spaces being created. Other pieces involve various attempts to join up or leave disjoint the depth suggested by the projection and the stage space. Initial intentions in *To the Unborn Gods* were to present the illusion of the projected space being a continuation of the stage space. It is questionable, however, whether a satisfactory solution could have been found which would make the illusion compelling for all audience members no matter what their location and orientation with respect to vanishing points and the like. Such attempts usually involve audience members to the extremes of the audience space

experiencing 'kinks' in what are intended to be straight, receding, perspective lines. Naturally, perspective projections which break from Rennaisance traditions could be experimented with and maybe other compelling illusions could be uncovered which would be experienced by audience members throughout the audience space. Such experiments would be quite a profound undertaking and would go against the grain of most commercially available graphics rendering libraries and (even) hardware support. We do not have examples here of such experiments in performance settings with the partial exception of *Lightwork* with its concern to allow contradictory perspective projections between the virtual graphical material and photographs (e.g.) used as textures on distorted objects in the virtual environment. While this involves experimentation with perspective projection, the intention is not to heal the rift between stage space and projection space. Finally, *Cyberdance* involves the projection of animations of a trio of virtual dancers and a real-time dancing avatar. These dancers inhabit their own stage space and environment *within* the projected video. Again, no attempt is made to integrate stage and projection space.

A critical series of questions can be posed with respect to the relationship the projected space has to the stage space. Is the work concerned with what might be called 'virtual scenography'? In its (even in its second best, compromised) realisation, the projection space of *To the Unborn Gods* can be regarded in this way. This is certainly the effect gained in *Video Only*. On the other hand, the authors of *Lightwork* were most concerned to avoid this. The projected virtual environment is the product of the performers' improvised constructional work, it is not a setting for their actions. As emphasised in Deliverable 2.2, the performers of this piece did not regard their projection as scenography and hence do not see themselves as actors.

Another critical question: does the projection correspond to someone's viewpoint or is it more akin to a camera angle? In *Cyberdance*, a virtual camera's view was adopted, giving the piece some cinematic or televisual components. In *To the Unborn Gods*, the viewpoint projected can sometimes be seen to relate to the fantasies and unconscious, dreaming life of the main protagonist. In *Lightwork*, a mobile viewpoint is used but it does not correspond to any particular character, embodiment or dramatic focus. It is rather a mobile centre of vision, a concentration of light, without a necessary embodied association. In future performances, it is being considered whether to display three mobile viewpoints onto the same common environment in a kind of dynamically varying triptych. In keeping with the improvisatory nature of *Lightwork*, the relationship between these three viewpoints will be varied in performance so as to experiment with relations between them: made identical, decoupled, disjoint, lagging behind, overtaking and so forth. These would further amplify *Lightwork*'s concerns with multiplicity of perspectives coexisting the one with another. It also re-raises the (still open) question for the workers on this piece as to whether any specific object or (even) an embodiment need be associated with the three loci.

Another possibility is for the projection to be a window on some external world illusorily situated behind the screen. It is anticipated that some uses of projection in *Mimoid* will be of this sort providing a view outside of the space station.

(4) The audience space. In *Cyberdance*, *Video Only* and *To the Unborn Gods* a traditional auditorium setting prevails with a seated audience exposed to the performance full frontally. *Lightwork* was not performed in such a setting and a standing (and potentially mobile) audience stood before the performers but again in full frontal orientation. Clearly other forms of staging are possible, perhaps borrowing from theatrical experiments or the

circus (e.g. the audience could be arrayed around a floor or roof-located projection). Some of the work discussed in this Workpackage gives a special treatment to sound vis-a-vis audience spaces. For example, in *Lightwork* four speakers are arranged to mark the intended boundaries of the audience space and a variety of sound movements take place in relation to events projected and actions performed. In *Video Only*, while performers enter from backstage, their voices appear from behind the audience.

Eliminating Spaces, Superimposing Spaces

There is clearly more room for experimentation in staging performances than has yet been reflected in the extended performance work within eRENA. Even though theatre and cinema comprise very strong legacies (which we can learn from as well as try to surpass, see Chapter 2), it is not hard to imagine stagings which go beyond the four way distinction noted above. Any one of the spaces could be eliminated either actually or in its phenomenological effect. Audience space could be eliminated in, say, an entirely Internet based performance. *Lightwork* has made some effort to phenomenologically narrow down stage space but this hasn't yet been as wilful as it could be. Backstage could be eliminated so as to display a work for the technical artifice that it is. Spaces could also be superimposed. A crude example would be to perform within the audience or to project over them. These are not, of course, unfamiliar themes within the history of the performing arts.

Mimoid takes a step into more novel territory with the notion of a distributed performance with varying relations between the real and the virtual at different sites. Details of this are yet to be fully realised but a number of challenges will have to be met. If anything this ambition of *Mimoid* raises to a second power what are already difficult issues in performance staging—especially as the proposers of *Mimoid* are also considering the possibility of simultaneous Internet broadcast. These are not challenges to be shirked however. Indeed, the *Mimoid* work suggests to us clearly the possibility that any one of the spaces within the 'performance architecture' could be made multiple. (It is to be noted that *Video Only* also describes a two site performance with some experimentation along the lines suggested in the *Mimoid* proposal. Also, segmentations *within* audience and performance spaces have been discussed in other work in eRENA, most notably in the context of Inhabited TV.)

Clearly, the challenge for the development of electronic arenas for extended performance is allow any or all of the distinctions hallowed in traditional theatre and cinema settings to be deconstructed, made multiple, combined and recombined in new forms.

Audiences

We have already touched upon some aspects of audiences in discussing their 'space' above. A critical question for extended performance concerns the role of the audience. In particular, can they participate in the performance in ways which are deeper than in traditional theatre or cinema? All manner of techniques and antecedents can be entertained here with, at one extreme, the elimination of performers in favour of audiences constructing and performing an extended work in some sense themselves. The examples available in Workpackage 2 for the most part seem to suggest an audience a seated

audience passively consuming the performance piece. Though the audience to *Lightwork* was standing and potentially mobile none of them chose to take advantage of this. To be sure, all pieces are concerned with confronting audiences with new experiences, sometimes problematic ones, the problems arising specifically for them qua audiences. For example, *Video Only* manipulates audience attention and expectation through various illusions and inter-relations between sound and vision.

Other Audiences

Mimoid makes the interesting proposal that visual features of the audiences themselves may be used to texture virtual worlds in performance in real-time. An allied suggestion would be to use audience activity to somehow parameterise algorithms used for the generation of virtual worlds or animations within them (cf. the work on Wobblespace conducted within eRENA at BT Laboratories).

Radical reconceptualisations of the status of the audience are yet to find their way into the demonstrated work discussed in Workpackage 2, yet it is clear that electronic arenas need to support a variety of audience roles and statuses. Within eRENA, interestingly, perhaps the most thought through contributions along these lines have come in Workpackage 3 with its concern for Inhabited TV and active participation within that very medium seemingly most hostile to the active, participatory audience: broadcast television. In future work on extended performance within eRENA, perhaps the VIP model documented there will form a useful starting point.

Performers

The different kinds of performers to be found in the performance pieces within this Workpackage make for some interesting contrasts. In *Cyberdance*, the performers are contemporary dancers. In *Video Only*, a variety of presenters, actors and dancers were involved. In *Mimoid*, a singer is a central protagonist along with a small ensemble. Similarly with *To the Unborn Gods*. In *Lightwork*, the performers have a history as performing musicians but an important theme of the piece is to make musical gestures (e.g. the playing of a wind instrument) have very different consequences from what might be expected. Alongside the humans involved in these pieces are a retinue of avatars, virtual embodiments and other animations. In *Cyberdance*, for example, we witness humanoid avatars in a choreographed animation or responding in real-time by following the movements of one of the human dancers. Of the pieces here, only *Lightwork* refuses so far to introduce any kind of avatar or explicit artificial agency into its improvised virtual environments and this for the reasons explained in Deliverable 2.2 (though this *may* be revised in future versions). The artistic purposes and activities of the avatars are very variable—as are their relations to performers. Sometimes they are projections (in a psychoanalytic sense) of an aspect of the performer's role. Sometimes they are deliberately simple and toy-like (as in one sequence in *To the Unborn Gods*) in their movement, othertimes their articulated gestures are intended to be humanoid and in some sense realistic (*Cyberdance*). Sometimes artificial agencies in the works are intended to have a kind of life of their own (*Mimoid*), othertimes their actions are closely coupled to a human performer (the real/virtual pas de deux in *Cyberdance*). Elsewhere in eRENA (see the performance works realised at Nottingham), virtual embodiments become the site of

explorations of gender, race and ethnicity—their design, for example, exploring what it is to be African, an 'alien' with a specific pigmentation.

Making Performance Activity Idiomatic for the Virtual

It is hardly surprising that most of the kinds of performance roles we witness in the performance works within eRENA are extensions, simulations or mere re-uses of existing performance roles and formats. Hardly surprising given the still emergent nature historically of virtual environments and extended performance techniques. Thus, we see variations on the actor, the (TV) presenter or quiz-master, the opera singer, the dancer. For their part, avatars too are recognisable as simulations, puppets, robots or whatever. It needs a conceptual side-step to think of performance roles which are more idiomatic for virtual reality. That is, can we imagine forms of performance which could only exist in quite the way that they do with the intense and ubiquitous presence of computational machinery and computationally rendered environments? This is not to say that we should fantasise about ridding ourselves of history or performance traditions but it is to seek performance activities which are indigenous to the new environments we are building.

Interaction as a Public Phenomenon

Essential for most common understandings of what constitutes a performance is that the forms of action and interaction that performers engage in are publicly available—specifically available to an audience. Even the most inexperienced of actors knows that the voice has to be projected so that the back row can hear even the most intimately whispered on stage moments. The embodied conduct of performers is modulated by the presence of the onlooking others. However, we are somewhat unused to thinking of interaction with technical systems in this way. In the literature on Human Computer Interaction (HCI), for example, the dominant scenario which drives research is one of a single human individual user interacting with a technical system via manipulations made at the interface. The user has a full frontal orientation to the interface and, perhaps, quite delicate actions (a mouse click here and key press there) have whatever effects the application in question has been designed to realise. The introduction of a third party to this scenario causes some problems. Is the newcomer to be situated alongside the first user? Do they share capabilities for interaction at the same interface? Is the newcomer to look over the shoulder of the user surveying what goes on there? This microcosm expresses some profound issues with interactive performance art. What kind of screen/interface do we have? What kinds of gestures are performers to make with respect to these interfaces? Do the audience get to survey those gestures or merely their effects? How transparent or opaque do we make the association between gesture and effect? All of these questions come to mind when we consider the extended performance setting. Performers are interacting with possibly very complex technical systems. What aspects of those actions are to be available to the audience and/or other performers? Are those actions and/or those interfaces to be specifically designed to project or to enable performers to actively project their occurrence and texture?

In Deliverable 2.2, the authors of the account of *Lightwork* joke that it is hardly an interesting matter to witness a 'performer' editing VRML files and yet it is the public performance of virtual worlds which is the topic of their piece. This joke highlights the

fact that actions at the interface to our technical systems in extended performance are to be an aesthetic concern. However, this does not have done with the issue because so many of our familiar technical systems (at least in their off the shelf versions) are designed with the HCI two party scenario in mind. To make gestures at the interface publicly available so that they may be analysed aesthetically requires new technical developments. (In some ways, this is why the technical challenges of designing for performance exceed those of designing for gallery or installation settings.)

These questions have been given considerable thought in eRENA and in this Workpackage notably. Chapter 2 of this Deliverable notes the danger of 'demo aesthetics' where moments within a piece or even a whole work are specifically constructed to show off interactivity. Nevertheless, *To the Unborn Gods* contains such moments and much of *Cyberdance* also functions as a demonstration as much as a performance. The close coupling of dancer movement to avatar movement in the section of the piece which involves real-time tracking of the dancer's body certainly demonstrates interactivity and publicly so, albeit at the cost of some variety in performance (the human and virtual dancers practical perform a unison work rather than an exchange of gesture).

The work at KTH on *Lightwork* has explicitly considered many of the issues involved in extended performance from the perspective of extending in turn research in HCI. This is why various notions of 'indirect manipulation' and 'algorithmically mediated interaction' are being experimented with as alternatives to the 'direct manipulation' (DM) tradition of HCI. While these techniques might seem appropriate for, say, amplifying user-performer's capabilities when interacting with a complex system (how else could one make virtual world construction a performable topic for a piece?), they run the risk of being illegible to third parties (audiences and possibly to co-performers too). Deliverable 2.2 and Deliverable 6.1 contain some extensive discussions of experience performing *Lightwork* with respect to these issues and argues for a hybrid approach where both indirect and direct interaction techniques are available and can be used for different kinds of performance gesture for different kinds of purpose. Nevertheless these suggestions remain unproven in a performance context. (Similarly, and similarly only partially tested, is the suggestion arising from *Mimoid* for a distinct architectural layer in virtual reality systems to support the smart transformation of performer gesture.)

Another feature of the work on *Lightwork* (and in Deliverable 6.1) is worth bringing out here and this concerns the 'latitude for expressivity' that performers have in an extended performance setting rich in embedded computational technology. There are good arguments for, on occasion, loosely coupling performer gesture to the technical system so as to allow performers latitude for emphasising what is occurring—even though this emphasis itself may be non-functional. Consider the following example. A tiny footswitch is mounted centre stage. When this is depressed an exceptionally loud sound file (say of an immense explosion) is to be heard. Alongside it appears a massive, Frankenstein's-laboratory-style lever which on being moved from one position to another, triggers a sound file of a pin dropping on a stone floor. Technological mediation (i.e. the triggering of sound files) enables a paradoxical relationship between what the device suggests and its effects. Our 'synaesthesic intuitions' may seem to be violated. However, much would depend upon how the devices are performed and, specifically, upon the (strictly speaking: non-functional) expressivity the performer inserted into this. For example, a performer may run across the stage and take a flying two footed leap at the footswitch or he may gingerly step up to it and gently depress it (and mutatis mutandis for the lever). In both cases (assuming a non-velocity sensitive footswitch), the functional aspects of the

performer's gesture are identical: a big explosion or a pin-drop is to be heard. But the expressive aspects of the gestures involved are quite different leading, one can imagine, to quite different audience experiences varying in their humour and surprise.

The example is given not just to indicate that there is more to an audience's experience of an interactive event than the narrowly considered functional aspects of it. It also indicates that a simple technical arrangement can allow great latitude for expressivity in performance. The same simple arrangement can be given quite different interpretations depending on whether a flying leap, cautious approach, finger and thumb lever pull or Boris Karloff style camp exaggeration is given to the gesture's execution. There is latitude for expressivity in such settings. An overly zealous technological agenda to extended performance (e.g. track everything that moves) might turn out to overly narrow this latitude.

Interaction Design for Third Party Legibility

The emerging challenge then is to design interaction methods and devices to realise them so that performance gesture is legible by onlookers. This requires a shift of perspective for much HCI research as well as mainstream research in virtual reality. What the foregoing discussion indicates though is that this does not necessarily require complex technological innovation. Indeed, pared down interfaces and sensor architectures may be more effective allowing the performer the expressive latitude necessary for accompanying the technically functional aspects of gesture with an audience-legible expressive encoding.

Devices for Interaction

In the extended performance pieces in Workpackage 2, we have encountered hats, costumes, electronic wind instruments, MIDI-faders and footswitches, touchscreens, and in Deliverable 6.1, we see discussed Theremins and other non-contact sensors, datagloves and so forth. In the non-performance settings studied within eRENA, we have seen deployed joysticks, bicycles, mice, keyboards, puppets, spaceballs and so forth. In short, all manner of physical devices can constitute the interface between the performer and whatever interactive system is in use. As in the gallery installation settings discussed in Workpackage 1, these devices may be selected for their degrees of freedom in a technical sense (the sensor configuration in *Cyberdance*), their symbolic value (the hats in *To the Unborn Gods*), their familiar associations (which may be perversely played with as in the case of *Lightwork*), they may be inherited from the performer's established skill set or a wider performance tradition (cf. Tod Machover's 'hyperinstruments'), or adopted unthinkingly or because there was no time to do better. Whatever. It is possible to attach some form of sensor technology to practically anything. This makes the design of the artefacts which performers manipulate a critical aesthetic and technical matter. The mouse-keyboard-screen trio of much HCI design should not be routinely assumed. Furthermore, it is possible to have forms of 'device-free' interaction where tracking or sensing technologies which do not require contact are used. The technologies involved can vary from effecting a capacitive field, diffusing ultrasound, breaking infra-red beams, through to capturing data from a GPS (global positioning systems) satellite. Such non-contact techniques should make us consider the design of the local space around the sensor (is it bounded or marked in some way?) and its spatial relations to other artefacts and locations

within the performance space. In such non-contact cases, perhaps it is better to speak of the space becoming the interaction device.

Motivating Device Selection

In principle, all of these design possibilities are available. The palette of devices is broad. What we lack is any accumulated knowledge or systematic understanding of which device, control surface or whatever to use for what purpose. Decisions tend to be made on a piece by piece basis or are such a central part of an artist's whole approach that 'selections' are never actually made. This is, of course, not entirely an unsatisfactory matter. It is not being suggested here that some 'science of devices' should ride roughshod over any particular artist's project. Rather, it is being recommended that we should be able to have at least preliminary answers, which could guide an artist, on questions like: what (on the whole) is the best kind of interactive system in performance to control with non-contact gestures? when is it appropriate to design devices with contact control surfaces? what is the appropriate number of degrees of freedom for devices to make them manageable? And so forth.

Intermedia Mappings

How do forms, events and activity in one medium relate to forms, events and activities in another? What kind of coupling exists, say, between the sonic aspects of a performance and its visual components? Are these couplings technically mediated or are they sustained through performer interpretation? In *Cyberdance*, dancers dance to music in a traditional way. Their gestures do not select the sequences of music to be played, nor is music algorithmically composed on the fly as a result of analysing dancer gesture-posture. These are quite plausible extensions of the work in *Cyberdance* (the authors are already considering posture recognition as triggering on the fly the selection of sequences of movement from an avatar dancer). In *Video Only*, some experimentation was engaged in to 'de-couple' and manipulate the associations between what was heard and what was seen in order to manipulate audience expectation and experience (cf. the relationship between performer's entry and their voices mentioned above). In *To the Unborn Gods*, a number of features of the projected virtual environment (animation behaviour and so forth) are coordinated with the actual performance of the music, though much of the control of the viewpoint is sustained through someone to the rear of the audience space providing a human link. In *Lightwork*, much attention has been given to this issue and the authors of the piece admit to an interest in 'synaesthesia' as a way of guiding such mappings. However, they explicitly reject crude mappings preferring, for example, only some of the objects in the virtual environment to be associated with sound and be given a location in the soundscape derived from the viewpoint function, or only some of the gross features of the environment, e.g. its overall rhythms of change, are taken to guide similar cycles in the music. In their experience, for this piece, closer mappings would have been trite. In *Mimoid*, a system of NSEW compass points is being explored to map spatiality with sound selection, though exactly how this will be implemented is not yet resolved. In any case, the artist-researchers involved with *Mimoid* are content if such mappings are available as a resource to guide the performer-composer, they are not seen as an essential feature of the audience's experience of the work.

Understanding Intermedia Coupling

A challenge for the future development of electronic arenas for extended performance is to more fully comprehend the effects of such couplings, when they need to be tight, when loose, when they do not need to be made at all or made only very approximately, when some reflection on synaesthesia (correlations between the senses) can guide exploration, when this would be trite, whether symbolisms (such as *Mimoid*'s Eurocentric bearing system) can ground such inter-relations, or whether this just multiplies obscurity. Close coupling of events in sound to events in the visual field, for example, can sometimes lead to an instance of what Chapter 2 refers to as 'demo aesthetics'—an effect is displayed simply to demonstrate what can be done—and a potential criticism of some moments within *To the Unborn Gods* could be made along these lines. In contrast, removing any form of coupling between music and visual effect would be to take a step away from interactive performance—music might just become a background for action or be used in some other cinematographically familiar fashion by default. Exactly what relations are to be established and how these are to be technically realised is a clear future challenge.

Narratives

The pieces available for inspection within Workpackage 2 vary in their narrative content or, for that matter, in their whole orientation to narrative formats. By narrative, we mean more than just 'story telling'. We are referring to the overall ordering of activity throughout the performance, how the action unfolds, how particular actions might form parts of sequences or episodes, how these are assembled, and so forth. It is possible, of course, to construct a piece without such a sense of overall temporal structure so that, for example, the audience experiences a series of performed moments each exhibited in turn, but all our works have some narrative sense. In *Cyberdance*, for example, the moments with virtual dancers are prepared for by dances of a more traditional sort (i.e. non-technically-mediated) before them. There is a sense of 'leading up' to the introduction of virtual humanoids. Indeed, there is a hint of an evolutionary-cosmological narrative at work here which introduces the virtual beings as a step along the way from the (animated) creation of the world. *Video Only* involves an unfolding chronology of eight virtual stage sets, each with its own design and interactivity. Though involving complex interweavings and references to multiple sources, *To the Unborn Gods* has firm narrative structuring. *Mimoid* similarly interweaves a number of narrative sources and one can imagine that a final production of the piece will have a strong sense of narrative form: it is, after all, an opera.

Idiomatic Narratives in the Virtual

What new narrative forms might emerge which are idiomatic or indigenous to extended performance settings? What new narrativities might be possible in virtual space? In *Lightwork* we see some attention being devoted to this with the design of an interactive technical component concerned with narratological affairs—the so-called Interactive Narrative Machine (INM). The authors of *Lightwork* intend its narratives, its overall temporal structuring, to be improvised from within the performance much like other features of the sound and visual aspects of the piece. The intention is to enable

technologically supported narrative structure to emerge immanently from within performer activity rather than be foisted upon the improvised activity of the performers as some kind of externally delivered grid or script. *Lightwork* has, to be sure, key transitions (e.g. noticeable moments where one virtual environment is replaced by another) but these moments too are improvised and the precise form of 'what happens next' is given by calculations within the performance based on what has just happened. The INM enables one to edit a narrative rule set which influences how these calculations are made.

In the work on *Cyberdance* too, there exists the proposal as mentioned above that animated sequences for an avatar-dancer could be selected in response to recognised posture-gesture of the real human dancer. This principle could also be extended so as to support 'narrative from within' such that through these local transitions an overall form is ('immanently' rather than 'transcendentally') created.

Network connections could enable polymorphous narratives to be constructed on the fly from material collected from the World Wide Web. One can imagine a piece which involved the raiding of personal homepages for narratological content and their assembly into the tale of a distributed web actor, a Leviathan of little lifestories. Experimentation with intertwined narrative forms are not new—indeed, at the very emergence of the novel, Sterne anticipated many later re-discoveries in *Tristram Shandy*. Our point is rather to raise the challenge to usher into existence new narrative forms indigenous to the distributed electronically and computationally mediated setting for tale telling that the electronic arena for extended performance will be.

Collaborations and Other Practical Affairs

All of the pieces made available to this Workpackage are collaborations—in some case on a very wide scale (e.g. *Video Only*). The collaborative nature of the work involved in the production of a piece should not be ignored even though author-attribution practices in some quarters might pick out the proper names of one or two individuals and make them appear as primary. We are not at the moment debating the legitimacy of those author-attribution practices, rather we are insisting that the production of a performance art work should be seen as a species of cooperative, collaborative work in all but the most unusual of cases.

There is clearly much to learn about how such collaborations take place. Indeed, this has been made an explicit theme in some of the ongoing field research in the i3 project most closely related to eRENA, eSCAPE. What seems to be emerging from this research is in some ways a familiar picture of make-do, compromise, the management of extreme contingency, situated sometimes arbitrary decisions about courses of action, even on matters quite close to the very identity of a piece. In their candid moments, several of the authors of descriptions of the works we have reviewed confess as much. Some of the decisions made in *Lightwork* are reported as 'arbitrary' and the advance commitment to a performance date in relatively short order caused a number of matters to be compromised. In particular, the principles and devices for sound control were not thought through to the same degree as those for graphical control (though subsequent work reported in Deliverable 6.2 redresses this to a degree). Very similar experiences are reported in the account of the development of *To the Unborn Gods*. Just because Deliverable 2.1 focuses upon the products of technical development in *Cyberdance* (as does the brief description

of *Video Only* in this Deliverable) does not mean that the work involved in making them was any less a contingent affair. *Cyberdance* was certainly an intensely collaborative project as multiple authors at both Geneva and Lausanne are deemed as contributors to the technical work alone.

Aesthetics of Collaboration

Whatever else artistic production is, it is certainly a species of work. As suggested in the account of *Mimoid*, none of the artists or technologists involved in the works we have discussed lay great store by Divine Inspiration or Genius—even their own! It is one thing to recognise this. It is another to make that recognition something which guides and configures future work. It is yet another to make the forms of collaboration and cooperative working which one might engage in in the production of a performance art work themselves an aesthetic concern. That is, maybe a challenge to be identified is to make the work involved in a piece not merely an object of study and deliberation but a matter of aesthetic design. This is not to argue, of course, that aesthetic production, when it starts involving software technologies, should have imported into it all of the methods for software engineering that are supposed to guide or (at the extreme) regulate professional practice in that domain. Far from it. That would be to mandate a particular 'aesthetics', a particular value system, one of technical rationality, efficiency and a form of professional accountability which would certainly not be indigenous to artistic production. Such proposals would be rightly resisted.

What is being suggested here is more akin to the surrealists' concerns with making techniques for the collaborative production of art available as public, repeatable methods, each open to aesthetic scrutiny. Many artists have experimented with 'systems art' where some predefined process is set in train and the design of the process is seen as a site of aesthetic deliberation. That too is a reference point. But both of these are only partially relevant largely because both have a partial understanding of the practices of artistic production and neither are as deeply concerned with the haeccities of artistic production in environments where specifically computational machinery is ubiquitous. It is making these practices in these contexts a matter of aesthetic deliberation, reflection and, in an appropriate sense, design that we are urging. Assembling the right skill mix (as emphasised in Chapter 2) is but one component of this, assembling the right practical methods is another, working out legitimate working divisions of labour yet another, and experimenting with all of these as a feature of the artistic activity is perhaps preeminent. In arguing for this, we are extrapolating from some hints in the *Mimoid* proposals: the work of technical development can be a topic for aesthetic design.

Traditions

Chapter 2 emphasises just how deeply rooted many traditions of performance are and how—even when we do not realise it—they infect the most experimental and radical of ambitions to be wholly innovative. There is a lesson here of course and that is that one departs from a recognisable tradition at the risk of unintelligibility and bewilderment. The risk is that performance which cannot be situated in relation to one or more traditions will be experienced not as new, challenging or marking the emergence of unprecedented forms but will simply leave us without the ability to make sense of things. As a matter of theory,

questions of tradition and the burden of history have been debated from modernism's rejections or inversions of the past through to postmodernism's incorporation of multiple pasts, multiple histories and traditions, juxtaposed against one another to cool ironic effect. As a matter of their practice, our performers gain considerable succour from traditional forms and codes of interpretation.

Most of the pieces discussed in Workpackage 2 require a conventional staging (or some small adaptation to it—the insertion of a big projection screen, for example). Two of the pieces characterise themselves as 'operas'. One has elements of a televisual variety show. Another is firmly rooted in contemporary dance. Yet another invokes surrealist and allied artistic traditions when speaking of its interest in combination and juxtaposition of heterogeneous elements in an improvised fashion to allow new associations to be constructed. *Mimoid* intertwines a number of literary elements, most noticeably Stanislaw Lem's novel *Solaris*, and will have to confront a number of familiar problems of adaptation (e.g. how to handle the refocussing from one character's viewpoint to another to a dispassionate narrative voice that a novel can achieve effortlessly, how to 'reincarnate' internal monologues and sequences of thought). Above, as in Chapter 2, we have been able to identify theatrical-dramaturgical and/or cinematographic elements in most of the pieces.

New Emergent Forms?

Our historical situation is well signalled by the billing of *To the Unborn Gods* as part of a program of "three multimedia operas". That is, we do not have yet new forms. Rather, we have modulations of old ones. The modifiers 'multimedia' or 'virtual reality' appear before 'opera'. 'Cyber' is conjoined with 'dance'. The strange is attached to the familiar. This not a simple matter of naming. One does not create new forms merely by finding a suitable name. Rather the naming practices reflect our unease about making it plain what a piece consists in and what an audience can expect in return for their money or their time. It is possible to read Chapter 2 of this Deliverable as suggesting that we are witnessing a further refinement of cinematic and theatrical performance traditions, with virtual reality technology comprising just another kind of 'special effect', and *not* seeing the emergence of new idioms. All these conclusions are highly debatable but whatever else an 'electronic arena for extended performance' must be, it must be a setting in which these debates themselves can be prosecuted.