array

2013 - 2014

the journal of the ICMA

array

Christopher Haworth, editor
Jen Wang, designer

The International Computer Music Association

Contents

Letter from the President
by Tom Erbe

August 31, 2014

Dear ICMA Members,

I am very happy to see a new issue of Array, just in time for the 2014 ICMC in Athens, Greece. This is our first issue since 2011, and the first issue with our new Array Editor, Christopher Haworth. I'm thankful for Christopher's contribution to the ICMA, and hope that this means we will return to a yearly publication schedule.

I want to take a moment to thank all of our new and our continuing board members. These are completely voluntary, uncompensated positions, and without the generous donation of time and energy, the ICMA and ICMC would not continue.

This year is somewhat of a reboot of the ICMA, with many new faces joining us on the ICMA board, or as ICMA officers. In addition to Christopher Haworth as our Array Editor, I would also like to welcome Arshia Cont of IRCAM as our new European Regional Director, Eric Honour of the University of Central Missouri as our new American Regional Director, PerMagnus Lindborg of the Nanyang Technological University as our new Music Coordinator, and Michael Gurevich of the University of Michigan as our new VP of Membership. And of course, this is my first year as President of the ICMA.

With such change, it will probably take us a few beats before we can get things going smoothly, but soon we'll be able to maintain the high level of excellence set by our former president, Tae Hong Park. Under his direction, we have accomplished many important things. First in my mind is the online archive (at the University of Michigan) of all papers presented at the ICMC since 1974. Having this online will expose anyone interested in computer music and audio to the important work our members have done over the years. Second are the student travel grants. It is very important to us to encourage new researchers to present their work at the ICMC, and the travel grants aim to reduce one potential obstacle. Finally, Tae Hong has maintained the consistent excellence of the ICMC conference, keeping it a truly diverse and international forum for computer music research.

In the upcoming year, we have several goals. First is to increase the student travel scholarships. Second is to increase the communication between the ICMA and our members through social media, email, and of course, this publication. Third, we plan to collaborate with the Electro-Acoustic Music Mine project to archive all of the music performed at the ICMC (NYU libraries have committed their support, and server space, for this project). We anticipate this will be as important a research resource as the ICMC proceedings archive at the University of Michigan. Finally, we are committed to our main purpose, putting on and improving the yearly ICMC conference. And for this, we are always looking for potential conference hosts. If you have any interest in hosting, please contact our Vice President for Conferences, Meg Schedel, or myself.

For all these activities, we rely on your input, comments, and participation. Please feel free to contact us with any suggestions, ideas, or concerns.

Hope to see you in Athens!

Tom Erbe
President, ICMA
Associate Professor of Computer Music,
UC San Diego

Letter from the Editor
by Christopher Haworth

As Tom mentioned, we are keen to have Array return to an annual publication schedule as of this year. The next issue will be broadly directed to a theme: the changing relationship between 'art' and 'popular' musics in the computer music community. Ten years ago, genres such as noise, electonica and electronic dance music were represented at 'off-ICMC' concerts; fringe events scheduled simultaneously with the main conference. But the introduction of club events and late night concerts, not to mention the rise of boundary genres such as live coding, suggest that important changes are taking place. If you have something to say about this changing relationship, either as a concert-goer, composer, or otherwise, then please get in touch with me at the address below. We are keen to hear from you.

As always, Array needs reviewers. If you would like to write about a publication, concert, new record, or similar, then again, write to me at address below.

Finally, I'd like to say a big thank you to the former editor, Scott McLaughlin. Much of the credit for this larger-than-usual issue goes to him.

array.journal@gmail.com.

ICMC 2011 Keynote Address, Music Imagination Technology

by Simon Emmerson
given at the University of Huddersfield, UK, 31 July - 5 August 2011

Abstract

Our subject is much the richer in all its many forms for the vast contribution made by Max Mathews. He reflected and I discuss further the transition from technologies of information to those of the imagination. But how can we better externalise what we imagine, to use it more directly in the creation of sound and music? I discuss notation and evocation of sound, different modes of imagination and the intervention of memory. I suggest that interactivity is not exactly the same as 'response', and how meaningful response might be a better way of looking at 'liveness' in music making. I suggest the 'animate net-work' as one idea of mediatised performance ensemble. Do we hear cause or effect? – I suggest the latter is more important but that this can vary between listener and performer. Alan Turing gives us a view of the unexpected and the difficult within the apparently intelligent behaviour of systems. Finally a return to rendering the imagination in three dimensional space – a movie or sculpture perhaps might help, with a final reference to such a vision from playwright Denis Potter (which I had discussed with Max Mathews some years before).

Max Mathews, without whom...

I forget when I first met Max Mathews. My copy of his seminal text *The Technology of Computer Music* (Mathews, 1969) is dated May 1978 purchased in the MIT Press store itself on a trip to the USA while I was working on my PhD. I followed his work in the 1980s but only got to know him personally in the 1990s in Bourges where we were both members of the *Académie Internationale de Musique Electroacoustique*. What we talked about over breakfast was more likely to be British produced TV plays that he and his wife Marjorie made a point of watching, than anything about computer music. Indeed I clearly remember in one such conversation recommending a specific TV production to them which I shall return to later in this paper – not by chance, I described then some of the computer-generated visual effects in the context of the drama.

Not only was he the creator of the first true computer music programme but his contribution to live music making (Groove), new interfaces and instruments (the electric violin), culminating in the radio baton is fundamental. This, linked to score tracking of both traditional and newly composed music, was a major contribution to live and real-time computer music. There is not an area of our field to which Max did not contribute. I will always remember his imaginative and sometimes provocative contributions to debates in the aesthetics and research initiatives in our field at the *Académie* – always central to his views was the perceiving subject – that may seem surprising given that he spent so much time helping us create and perform sounds and processes through digital means – but to Max these were always at the service of the listening experience which had limits of physiological, psychological and learnt nature.

From 'information' to 'imagination'

This shift (from an emphasis on information to imagination) can be illustrated in Max Mathew's own words from near the start and end points of his career. Firstly from the seminal article 'Generation of Music by a Digital Computer', written with Newman Guttman in 1959, when computer music was all of one year old –

> Potentially, a digital computer may generate any sound [...] the digital computer may produce infinitely many sequences of numbers and hence an infinite number of sounds.

And then from Tae Hong Park's interview with Max in the (effectively 80th birthday) 'tribute' edition of Computer Music Journal (2009) –

> The question which is going to dominate the future is now understanding what kinds of sounds we want to produce rather than the means of usefully generating these sounds musically. This is going to revolve around experimental psychological studies of how the brain and ear react to sounds, [...].

At first the clear and logical definition (in the article) of the information structures necessary for the generation of *any* sound – from the sample to the waveform.[1] But secondly the increasing need to understand the actual *sound event* as a perception and how humans react to it. This is a rich insight – what do we want when we can do *anything*? What are the limits of our imagination?

The limits of imagination

Max Mathews intended his second point to be reversible as in all good scientific research – one of the aims of the study and understanding of human psychological reaction to sound would be to encourage the reverse – the ability to start with ideas of human reaction

and work out into the sound. In our imagination we might have only a very fuzzy idea of what we seek but we need better tools to externalise and test our potential.

To this end I would like to harness and extend an idea described and developed by Michael Casey in his idea for 'Automatic Foley Generation' – "The audio for an interactive game can be generated from a structured audio description of the materials and action parameters of a scene." (Casey, 1998, p.16). But he goes on –

> An extension of the automatic Foley application is the Producer's Assistant. [...]The most desirable control pathways for such an application are those that offer physical object properties as handles on the sounds such as materials, size and shape properties.

Casey in this instance assumes synchronisation to a film or video track but I think the principles could be set free and if we could work to an *imaginary* scenario. The basis of his imaginary assistant is ecologically sound instrument construction – while for Foley work this might demand 'realistic' sound output all the physically modelled synthesis and excitation types he describes may be used for the widest range of sound types. How do our imaginative ideas become realised? How would we drive this producer's assistant? With an imaginary movie or (better) a movie of the imagination?

Notation and evocation

Notation in the western tradition started off as a 'memory jog' – a simple aid based at first broadly on melodic shape which would remind the singer of the outline of the pitches of the already learnt chant of the offices of the church; rhythm and duration were decided by a complex interaction of word, syllable and breath. Pitch had emerged as a dominant carrier of musical meaning – oriental notations well established prior to those in the west show a wider range of concerns including playing techniques for different timbral and expressive results. Pitch as a single dimension parameter was well suited to the graphic representation of the page; at some point in the early part of the last millennium its notation evolved from the simply mnemonic to the definitive (the prescriptive).

Much electroacoustic music belongs to an aural tradition, one with little or no human readable notation.[2] The need to somehow 'fix' this ineffable flux comes from several quarters. This led to the 'evocative transcription'. From the earliest days of *musique concrète* and from all traditions of later acousmatic, electroacoustic, mixed and live electronic musics have emerged 'scores' – clearly having different functions than the traditional western score. This includes the human performer at the mixing console wanting to present the work on a large sound system (the art of sound diffusion or projection), the musicologist seeking an outside-time representation to allow analysis of the music's 'working', its material and form. Sometimes such a visual representation can aid concentrated listening – which can then become listening out for – and to give pointers and emphasise the 'something to hold onto' (in Leigh Landy's terms [9]).
But an interesting additional type of score is referred to only in passing in much literature – the composer's sketch score. Expressing the possibility of projecting the evocative notation into practice rather than the reverse.[3] In suitable form this might link to Michael Casey's notion above. I am dreaming of such an evocative notation 'driving' his production assistant – with of course real-time input from the user.

A universal and agreed notation for complex sound is extremely difficult to conceive of. FFT representation may be 'objective' but has inadequate correlation to and evocation of the actual sounding result. Thus the historical process which happened a thousand years ago for pitch notation will not happen in such a linear way for complex timbre events and processes (I try to avoid the term 'objects'). An interesting hybrid of 'machine assisted' and manual evocative transcription has been pioneered in the Acousmographe (from the GRM in Paris). This left the subject users to define for themselves particular shapes, forms, colours and textures visually to represent certain sound qualities.[4]

It may be that some degree of coherence and standardisation could be established through more thorough research into evocative notation.[5] With the development of such representation software packages some commonality of these visual attributions might emerge. Experience and a lot of use will tell us what works.
In addition the principle of driving the transcription system in reverse is there in its infancy – and of course there is software to translate a repertoire of shapes, attributes, colours and textures into sound.[6] And if generalisation and universal agreement on notation is not feasible in the short term, personalisation of choices and preferences should be simple.[7]

There may be those from some post-musique concrète traditions who are horrified at the prospect of such a notation used to create electroacoustic sound.

Pierre Schaeffer' s disenchantment

with western notation was on account of its distance from the sounding result. That is the degree to which composition had become manipulation of abstract symbols on the page completely separated from the concrete experience of music as perceived. Recorded sound and the listening experience, without recourse to notation, combined to give (he believed) tools for a renewal of compositional practice.

I am not arguing for a counter move against this position – many have done that already; the notation I have suggested above does not possess such a definitive (prescriptive) function – it cannot, as there is no firm mapping of symbol to interpretation as there is in traditional western notation. The proposal inevitably retains an experimental fuzziness, an empirical uncertainty. The aim in such an 'envisioning' of synthesis is to allow greater imaginative play ...

Different modes of imagination

The operation of sensory interfaces to computers has often focused on the physical aspects of our bodily space – muscle activity, limb movement, breath. Even when extended to include the monitoring of electrical activity – bio-interfaces – these have until recently been kept at the level of monitoring physical signals. But we have recently seen Marvin Minsky rotating a shape on screen through thought alone[8] – the computer programme tracking Minsky' s brain activity through non-invasive electrodes, learnt the electrical result of a set group of mental operations (such as rotation). This was a 'learnt procedure' – none the less powerful for that and an enormous step forward. This is rather like voice recognition of course – the system learns your idiosyncracies on a 1:1 mapping to a dictionary.[9]

Oliver Sacks, in his book Musicophilia [15], reports extensively on what he terms 'musical hallucinations' where music appears as apparently truly heard yet unbidden to the consciousness through no external stimulus. His examples appear to be triggered memories rather than creative acts and are sometimes frightening to read. Composers vary as to what exactly they say they do when they 'imagine sound' or 'imagine music'. There is also a tendency to bracket together 'imagery' and 'imagination'. While the two have the same origin in 'imago' we can make a distinction between them. And we may do a lot more than 'imagining sound' when we conceive of a piece. We may imagine a scenario, an instrument, a performance, a sense of space and place. We may also imagine a complex relationship expressed through mathematics – and many mathematicians claim to deal with symbols somehow 'out there' in space.

Then we have specifically musical functions, composers have often described the sense of form they have held in their imagination – and these are sometimes described as somehow 'outside time'. From Mozart to Stockhausen some have claimed to 'see' forms of works in an instant. This suggests somehow an 'outside time' representation. It also suggests a preoccupation with form as a kind of architecture not merely 'outside time' but 'in space'. Webern in his 'Path to the New Music' [18] confirms that he, Berg and Schoenberg worked from 'an intuitive vision of the work as a whole' - which came in a flash of inspiration – to the details. This is particularly strong in the Austro- German tradition. Goethe is often quoted by Webern but here by Xenakis – "Goethe said that 'architecture was music become stone'. From the composer's point of view the proposition could be reversed by saying that 'music is architecture in movement'." (Xenakis quoted by Le Corbusier ([10] p. 326)

Memory

It could be then that imagination is simply anticipatory behaviour - a tool for survival. But as one theory suggests it has expanded into the mental bandwidth previously occupied by the need to memorise – whether Homeric epics, routes for navigation on land and see – before maps, writing and other 'externalised memory'. I declare a frustration – throughout my life I have heard sounds while driving that I have wanted to capture. (Stockhausen ref.) Any attempt to do so has been fraught with impossible conditions. Sounds on the radio at but not beneath the ambient noise floor; the strange qualities of wind and water sounds; are some typical examples. All attempts to mimic them later in the studio have failed although the attempt has sometimes been worthwhile.[10] This has led to this request for more flexible, tactile and interactive ways to externalise imagination and effect its synthesis into sound.

From interactivity to response

Interactivity means a wide variety of things in computer assisted music. I want to look at some of them and extend the discussion to see how this relates to the notion of 'response'.
My dictionary tells me - Interaction - reciprocal action or influence: Response – a verbal or written answer to a question, possibly a reaction to something; - but this sounds like 'reply'. More relevant is the Latin origin my dictionary tells me means 'something given in return' which has a closer ring to how I understand it. Yet even this is not clear enough. I have written much over the years about the 'live' in 'live electronic' music. Only recently did I move beyond the crude physical world models around when I was a student: 'a human playing something,

making sound mechanically to be manipulated electronically'. Of course we need to overlay that with psychological worlds (of will, choice and intention) and social worlds (of being with others) – all three interpenetrate in 'living presence' [4].

I am increasingly of the view that liveness is about some notion of meaningful response. Let us step back a pace and arrive at that more slowly. Causality has been fraught with problems in the realm of physics, from the atomic to the cosmological. But we must tackle it to make sense of the world at the scale we encounter it.

In computer processes we often set up simple causal chains - In a world of agents called X, Y, Z etc. we might observe actions A, B, C, ...G etc. Thus if causal action is simply of the form: A (in X) causes B (in Y) -
then interaction adds the return path: A (in X) causes B (in Y) causes C (in X) etc. But we must be careful. As a musician if I 'call' and you 'respond' – I have not caused your response in the same deterministic sense. I might be said to have provoked your response through social and musical convention. We cannot easily avoid this 'transfer' problem but need to be acutely aware of it. Thus the perception of an appropriate and meaningful link in this interactive chain pertains to the nature of B with respect to A, C with respect to B etc. not simply to the nature of the causes. Where the nature of the result is appropriate and meaningful crude interaction becomes true response.

Our dictionary definition seems limited, also, to two entities. Networks do not act so simply. Where every element is potentially connected to any other causal chains are more likely: A (in X) causes B (in Y) causes C (in Z) etc. [... eventually] causes G (in X). Of course the chains themselves may also reconfigure dynamically. Furthermore in real performance systems a single action can have consequences in more than one element - A (in X) causes B (in Y) + C (in Z) + etc. There are here attendant multiplicative consequences – some possibly unstable and catastrophic.

Interactivity at micro and macro event levels

There are of course a range of possible aims and outcomes parallel to concerns in sound perception studies on the relationship of micro to macro events. In a David Tudor inspired system, or (for example) in the construction of a swarm driven piece,[11] micro-level causalities and interactions create large numbers of events which might possess emergent holistic properties. The agents are small entities which interact with immediate neighbours according to (often simple) rules. At a high level, simple actions input to the system might cause complex emergent results, and it is these that are the intended outcome of the action.
Matt Rogalsky has written recently about David Tudor's Rainforest - an open work, electronically as well as mechanically interactive.[12] Tudor's own descriptions of Rainforest over many years present an array of references to nature and the natural: it is variously "an environmental piece" (1974), "An Electronic Ecology", "an electroacoustic environment", "acoustically environmental" (1981). [...] In its 1973 version, [...] a complex environment is created where electronically generated sounds intermingle with field recordings and they frequently become confused. What seems to be an electronic sound might well be a recording of a frog pond; what sounds like chirping birds might be a feedback circuit assemblage of guitar effects pedals. [14]

An ecology is (as we are learning to our cost in our world today) a system in which all components are interactive and interdependent to a degree.
But if the agents X, Y, Z are complex high level entities quite perceivable by an audience (for example performing agents). Then causal chains are likely to be at the music event (macro) level directly available to the listener's perception – that is we are meant to follow the pattern of their individuality in sequence – and their interactive consequence.

Hearing cause and effect

There is a clear distinction between hearing an action or process and hearing the result of an action or process. It seems more obvious if I put this in the form – you do not always hear a cause,[13] you hear its effect. With this in mind I have always doubted the very limited debate about 'hearing algorithms' or indeed any generative procedure whatsoever. We must not fall into the trap of reducing music to a game of consequences – a guessing game of 'what caused that?' That may be fine for professional composers (and computer music conferences) because we really do want to know the answers! – but is not usually at the centre of the expressive musical experience.
Thus the aim of serial manipulations was not to 'hear the series and to work out its four forms and their transformations' in the mind of the listener. Xenakis did not intend us to 'hear Brownian motion' (gas molecules moving) in his work Pithoprakta;[14] and I do not believe composers normally intend us to 'decode' chaotic and fractal generators or neural networks (as such) as generators of musical material. Yet each of these has clear consequences in the sounding result even if we cannot consciously grasp what caused it. If that relationship is strong (that is with clear characteristics which

appear not arbitrary) then the processes has at least functioned 'effectively' (that is not the same as aesthetically or musically successful).[15]

If we as listeners cannot always consciously decode interactivity we can certainly perceive its result. In traditional music making of many genres we might say we sense interaction in an ensemble – where in fact we sense the results of interaction.[16] From a great jazz group, string quartet or live electroacoustic piece we lock into and follow 'something'. Here, too, (as above) interaction has both micro- and macro-level aspects, from the tightness of synchronicity to the fecundity of exchange at music material level, call and response.

Performer / listener distinction

But we have inadvertently separated the listener out as somehow privileged in this discussion. The perception of interaction may be substantially greater and more important for the performer. The statement we made earlier - A (in X) causes B (in Y) - seems to ignore who is doing the perceiving, and how that person got to know this. For the performer this may be entirely different than for the listener – and both different from the composer. We may have got locked in technical description here. We composers may know that 'A causes B' due to a particular relationship within our Max patch – that's simply 'how it works'. The listener may only have the sounding stream with inadequate visual confirmation (or none at all).

More importantly, a performer is quite used to sensing micro-level changes in timbre, pitch and loudness of their instrument and is in the privileged position to sense relatively small consequences in the live electronic system and interacting with them. The entire enterprise should perhaps focus more directly on the effect this has on the performer and performance. If this enhances the musical result then the interaction has clearly functioned positively and truly 'responded' not simply replied. The performer may know this well through rehearsal and practice – they may want to comprehend fully the exact cause of any response to what they do. Whether the interaction between performer and technology has as such been perceived and 'decoded' by the listener is however quite secondary. As listeners we should perceive its robust result (the effect) not necessarily it (the cause).[17]

Response to the unexpectd, the unknown, the unplanned, the disturbing

Alan Turing's famous test (actually a game) [17] is much mis-summarised in the literature. An interrogator addresses two separate entities believed to be people s/he cannot see. S/he is told that one is male, the other female – and that the female will be helpful but that the male will be unhelpful and may lie, in response to questions. The interrogator must decide which is which. The game is repeated many times. Unknown to the interrogator the real male human is occasionally replaced by a machine. An analysis of the results can tell us if the machine has succeeded in 'tricking' the interrogator into making a misattribution of its gender identity. If equal to or more successfully than the real human it might be said to be behaving intelligently.[18]

Do we make a distinction between behaving intelligently and behaving in a human way? Turing's insight that it takes intelligent behaviour to deceive successfully is easier to apply to language but not to music. I have discussed the possibilities and limitations of applying a kind of Turing test to live electronic music elsewhere [6]. But in summary I am led to conclude that in future we may simply not be able to ascertain if our fellow performers (if not present in the room with us) are human or not.[19] Let us return to Alan Turing and the possibility of deceiving the observer. I wrote in [6] – The role of the 'trickster' M[ale] is not easily modeled [in musical terms]. But there may be an equivalent somewhere: Creativity and the unexpected? The 'unwanted' musical event? Trying to put you off your stride, testing you? Being irritating? (The speck of grit that becomes a pearl.) These may be fundamental to our perception of 'the human'.

This is certainly beyond the simple throwing in of a chance occurrence. Whereas some 19th century philosophies of music came up with notions of artistic 'truth', it is sometimes unclear whether its opposite - 'falsity' or even 'lies' - is anything more than 'bad art' that simply fails to live up to such high ideals. Thus for all my attempts to move us from a crude interactivity to deeper response, there is always the need for the irrational, the unexpected, the accident, the glitch which function to challenge and potentially to change the ongoing cause-effect and response chains. In other words to innovate.[20] Our computer may need to be tired and irritable and do the musical equivalent of throwing something down onto the table.[21]

Response, expressivity, location, time

So why does interactivity remain so important to us? I want to tie this back to liveness. Interactivity like word processing may become a phrase we no longer use. It will simply be absorbed into 'the normal way we do things'. Systems which ignore mutual influence and meaningful response between elements will tend to be the

exception.

As an example, let us take the most traditional live electroacoustic performance in concert. There are three agents - performer and machine are taken for granted but let us restore an element so often ignored and remember its influence on the final result – the environment, the location - all aspects of it from acoustics, layout to sociology - the 'feel' of the place.[22] There has always been a tension between a 'white box/ black box' gallery style neutrality and the desire for 'character' in performance spaces. Whichever - any performer adapts to such a performance space in some way. But this generates a problem with fixed and absolutely timed 'instrument with electroacoustic sound' genres (called 'mixed music' in the French tradition). Until recently, in this kind of work expressive timing in performance (in part a response to the space surrounding) was severely constrained if not eliminated, the tape a ruthless conductor.[23] This combination will rapidly become the exception for just this reason.
Why be authentic? The technology already exists to perform a simple rewriting of this demand. We could add interactivity to pieces which were originally fixed in their relationships. Thus we could track the performer (whether against a traditionally written score or not) and compress or extend the fixed medium recording appropriately. The performer takes back responsibility for expressive timing. Or maybe the machine could change spatial diffusion options, reverberation and mixing, depending on the nature of the space.

The three elements thus enter into a tight interactive relationship. The human performer and the machine can both 'listen to' and respond to the space. The machine can track the performer and modify the passing of musical time. The performer responds likewise to this modification. The question of synchronisation – for example, a live instrumental attack simultaneously with an electroacoustic one – might be overcome by having a 'variable stopwatch' which clocks at a rate set by the interaction of file time and 'modified performance time' – or perhaps the sensing of an 'upbeat' gesture from the performer.[24] This interactivity is taken for granted in good traditional practice and needs to be restored to the relationship between human and machine – even for historical works that already exist. It is a 'normal' relationship in music making.

The animate network - interactive call and response

In a paper to the Australasian Computer Music Conference (Auckland, New Zealand) in July this year [5] I suggested that in future we may not strictly know whether 'other performers' are live or machine. I imagined an interconnecting web of agencies: human, environmental[25], computer-generated. I concluded that liveness may have more to do with the 'response' of such a network to an individual participant's actions – you perform something – what comes back at you? How do the other agents respond? This links that argument to our concerns here.

Such a network is impossible to draw (to visualize) – as is a map of any totally connected web - but somehow we can try to imagine it. I called it the 'animate net- work'. Now such an environment is clearly acousmatic in the sense of action at a distance without verifiable line of sight confirmation[26] of causes. So our task as creators[27] is to describe (and prescribe) 'response' between our three agencies: human <> machine, human <> environment, environment <> machine. Beyond that lie infinite possibilities combining installation, performance and network ecology. The scale of the animate net-work is of course completely variable from local to potentially world-size.

Space imagination

The fascination with the analogue world we have seen emerge in the last decade is surely in part due to its tactility - the physical positioning in space of knobs, dials and linear potentiometers was eclipsed by 'number boxes' rapidly on digitisation. Early Yamaha synthesisers pioneered the use of a single small digital display window to address maybe hundreds of parameters, a very small number at a time. We sense this loss of 'tactile location'.

But sound location is an increasingly important part of imagination technology in the increasing sophistication of the three dimensional presentation and an emerging compositional and aesthetic discussion [16]. Commercial applications (cinema 5.1 and its variants) remain limited – but I do not intend a technical summary here. Whether in the most recent BEASTmulch applications from Birmingham, the Zirkonium from ZKM Karlsruhe, the WFS system installed at the TU Berlin (and elsewhere). We need a much smaller composition studio scale version of this – I mean one the size of your desktop. Just as I see people watch videos now cut and mixed for mobile phone viewing, so I want this tactility in my hands in front of me.

It might be that the next stage of visualisation might be nearer sculpture than painting[28] to manipulate sound in space as a malleable (even fluid) substance – more accurately to place, dynamically move and smear sounds within that space which can then be projected out to performance. We have referred to sound

sculpture for many decades with respect to sound processing and synthesis. It is a metaphor that could be made 'real' through suitable haptic interfaces and three dimensional representation. How it would feel actually to 'sculpt' a sound is a non-trivial question. It shifts my imaginary metaphor for externalising imagination, too, from imagination as movie, to imagination as tactile activity.

The imaginative interface - how do we render the imagination?

Imagination - the faculty or action of forming new ideas, or images or concepts of external objects not present to the senses.

So finally – things might just be beginning. In that breakfast conversation with the Mathews in Bourges all those years ago I recommended a specific television production. In Denis Potter's final play created for British television, Cold Lazarus, the memories of a writer whose head has been cryogenically frozen for 400 years are extracted and projected in 3D into a relatively large space – we see memories of landscape and people, hear sounds and conversations which a small group of future scientists seek to make sense of.

This 'audio-vision' of the future (made in 1994 – the year Denis Potter died) was born of an intense nostalgia fuelled by a knowledge of the certainty of his impending death and loss of memory. It was clearly a wish fulfilment of something he knew he could never know.[29] The past is thus preserved and then projected into the present – memory becomes movie again.

What of the future – the act of imagination – what might be? - could this also not be projected in like manner to be rendered and synthesised at our behest? Of course this is not synthesising the future strictly but 'the imaginative present' – we might project what we hear (and see) in our imagination right now.

The separate parts of this paper have a kind of network quality – I am forced to present them to you in a fixed sequence but they interact across the page. In summary and conclusion the use of technology to harness more directly the power of our imagination – in all its technicolour glory – through the integration of analytical and synthesis media is occasionally but clearly glimpsed in contemporary developments. If fanciful and dreamlike it continues in a long tradition of speculation on the way we describe the imagination of sound - Shakespeare - The Tempest: ACT III scene ii: Caliban -

> Be not afeard. The isle is full of noises,
> Sounds and sweet airs, that give delight and hurt not. Sometimes a thousand twangling instruments Will hum about mine ears, and sometime voices That, if I then had waked after long sleep, Will make me sleep again: and then, in dreaming, The clouds methought would open and show riches Ready to drop upon me, that when I waked I cried to dream again.

And thank you Max, too, for your dreams and your realities!

NOTES

1. The identities of orchestra and score (in Music-N terms) emerged at this time and first made explicit in 1961 – see John Pierce's contribution to The historical CD of Digital Sound Synthesis (booklet).

2. Of course there may be a score in Music-N terms but that is not usually directly interpretable by the human reader.

3. I am grateful to David Gray (PhD student at de Montfort) whose thesis is on 'visualisation in electroacoustic music' for many conversations on this possibility.

4. A new software package EAnalysis is being developed by Pierre Couprie on an AHRC-funded project at De Montfort University ('New Multimedia Tools for Electroacoustic Music Analysis') as part of a more comprehensive 'toolbox'.

5. There is now over 60 years of examples.

6. Metasynth is one of the most important.

7. Judging by the emerging sales techniques on websites whose names I need not mention.

8. See http://www.emotiv.com/ - and their recent demo videos of mind controlling image on screen. Also Youtube movie.

9. The manufacturers in this case seem to promise games interactivity short-term.

10. These were at least real events and I leave aside a desire to synthesise the sounds of dreams which Hildegard Westerkamp alludes to directly in Kits Beach Soundwalk, a piece which I have always interpreted as a soundwalk within and around the imagination.

11. See the writings of Tim Blackwell and Michael Young (Goldsmiths, UK), e.g. [1]

12. While its realization was pre-digital I use it here as a paradigm case of a system which is a performance, a work, an environment, an installation without clear distinction.

13. I refer in Aristotelian terms to the

efficient cause of the sound, but the other causes are there for the 'decoding' from sound – the formal and material causes contribute to sound quality, of course.

14. Although he did refer to the more transcendental aspects of harnessing the world's (perhaps the cosmic) behaviours that lie behind the surface phenomena.

15. Of course there are examples of musics in which the overt process is intended to be perceptible, most famously Steve Reich in the first ca. ten years of his output.

16. This is a form of entrainment.

17. This is simply restoring where we were before electronic mediation – we do not need to devote too much bandwidth to decoding exactly what instruments are playing in an acoustic orchestra, eyes open or closed.

18. A strongly behaviourist argument. We should not infer anything much about human thought here – the response mechanisms of the machine may be very different to our own!

19. I shall argue in a later section that this need not be such a cause of anxiety or concern (see The animate net-work below).

20. John Bowers and Phil Archer [2] in their wonderfully thought provoking paper – 'Not Hyper, Not Meta, Not Cyber but Infra- Instruments' –sought to challenge the ever expanding world of controller power and to celebrate limited resources, simpler musical results – 'more from less'. A limit is not necessarily a limitation.

21. I suggest this area is vital for further research – see Andrew Hugill's *'Pataphysics: A Useless Guide* (MIT Press) [6] – 'pataphysics is the 'science of imaginary solutions'.

22. I have argued elsewhere that a full definition of genre cannot exclude the places and spaces of performance [4].

23. The pianist Philip Mead commissioned and championed a generation of works with fixed electroacoustic media but recently declared his 'distance' from such works – and the personal liberation of moving to freer, live electronic and improvised forms using Max/MSP (personal communication and MA thesis De Montfort University 2007).

24. This might be visual or physically tracked. It corresponds to Gary Kendall's Preparing > Starting section of 'Event Schema' ([7] Figure 3).

25. In that presentation (ACMA 2011 – [5]) I suggested the idea of the environment as a possible performative agent.

26. Schaeffer's idea of the acousmatic is difficult to maintain effectively in a network of telepresence, action at a distance, and latency. My present view abandons even trying to establish 'concrete evidence' as to who or what is where.

27. The composer and performer may be united in the term 'creator' even more than 'participant'.

28. The location of this talk in proximity to the Yorkshire sculpture park is particularly apposite. 29 Another theme in the work is that a group of terrorists with the motto 'Reality or Nothing' attempt to destroy all such virtual simulacra – immersive VR was just arriving at the time the programme was made.

REFERENCES

[1] Blackwell, T. and Young M. "Self-organised music", Organised Sound 9(2). 2004.

[2] Bowers, J. and Archer, P. "Not hyper, not meta, not cyber but infra-instruments", Proceedings of NIME2005, Vancouver. 2005.

[3] Casey, M. "Auditory Group Theory with Applications to Statistical Basis Methods for Structured Audio", PhD, MIT. 1998.

[4] Emmerson, S. Living Electronic Music. Aldershot: Ashgate. 2007.

[5] Emmerson, S. "Living in a performing world – performing in a living world" (Keynote Address ACMC Auckland, NZ, 2011) Proceedings ACMC 2011.

[6] Emmerson, S. "Live Electronic Music or Living Electronic Music?". In Bodily Expression in Electronic Music (D. Peters, G. Eckel and A. Dorschel eds.), Routledge, 2011 (in press).

[7] Kendall, G. 2008. "What Is An Event? The Event Schema, Circumstances, Metaphor And Gist", Proceedings ICMC Belfast 2008.

[8] Hugill, A. 'Pataphysics: A User's Guide. Cambridge: MIT Press. 2011

[9] Landy, L. Understanding the Art of Sound Organisation. Cambridge: MIT Press. 2007.

[10] Le Corbusier. Modulor 2. Cambridge: MIT Press. 1968.

[11] Mathews, M. and Guttman, N. 'Generation of Music by a Digital Computer'. 1959. Reprinted in The historical CD of Digital Sound Synthesis (booklet). Computer Music Currents 13.

Mainz: Schott Wergo. 1995.

[12] Mathews, M. The Technology of Computer Music. Cambridge: MIT Press. 1969.

[13] Park, T.H. "An Interview with Max Mathews", Computer Music Journal 33(3). 2009.

[14] Rogalsky, M. "'Nature' as an Organising Principle: Approaches to chance and the natural in the work of John Cage, David Tudor and Alvin Lucier", Organised Sound 15(2). 2010.

[15] Sacks, O. Musicophilia – Tales of Music and the Brain. London: Picador. 2008.

[16] Smalley, D. "Space-form and the acousmatic image", Organised Sound 12(1). 2007.

[17] Turing,A. "Computing Machinery and Intelligence", Mind 59(236). 1950. Republished at www.abelard.org/turpap/turpap.htm.

[18] Webern. A. The Path to the New Music. Presser/Universal. 1963.
372

ICMC 2012 Keynote Address, The Chladni Ostrich

by Seth Kim-Cohen
Given at IRZU Institute for Sonic Arts Research, Ljubljana, Slovenia, 9-14 September 2012

When Miha Ciglar originally invited me to give this talk, I declined. You see, my conception of a non-cochlear sonic art, is intended as a specific kind of corrective for sound art practices that are engaged with the history and aesthetics of the gallery arts. My hunch about the ICMC is that this gathering serves a different population and a different kind of practice. So I declined the invitation, mainly because I have no interest in telling people something they simply don't want to hear, something they probably don't need to hear. Miha tried to persuade me that the thesis of my book could be an important addition to the discourse here. Ultimately, the optimist in me prevailed. I accepted Miha's generous invitation, hoping that we might engage a productive conversation and – who knows – maybe even better ourselves in the process. I should've known better. Now the conference is upon us and, in the conference program, we read:

> As it was anticipated prior to the call for works, there were actually not many submissions referring to the conference theme.

So I'm feeling justified now in assuming that what I'm about to say may fall upon deaf, or even worse, antagonistic ears. In any case, I am not a dogmatist or a preacher. I'm not here to save anyone's soul. I am an artist and I wrote my book, In The Blink of an Ear, to address a set of presumptions that seemed to be informing sonic practice and the theory attending it. I was interested in better understanding my own work as an artist and how I'd come to make the work I make. In short, the only soul I hoped to save was my own.

I feel strongly that art both affects the world and is affected by it. To put it another way, art exists in relation to the world; it is in a relationship with the world. As with any relationship, all interested parties have responsibilities to one another. If we, as artists, turn our backs on the world, retreat to our bedrooms or studios and ignore the world – what it wants, what it needs, how it behaves – then we are bad partners in this relationship; the kind who say "not tonight honey, I have a headache" and then masturbate after honey falls asleep.

Just as importantly and just as verifiably, the practices and technologies with which we are engaged are not themselves free of the social, political, and historical, conditions that we refer to when we use the definite article and noun, "the world." On the contrary, the categories of artist, music, composer, and technology, are historically contingent. What we understand these categories to mean and how they determine our actions and attitudes in relation to them are the products of a series of events, figures, works, and texts, that have persuaded us that these categories are meaningful. It is useful to remember, however, that a mere tweak here, a swerve there, a different response, a blizzard, a budget cut, a less tenacious publicist, and everything might have been different. Likewise, the gadgets we employ are the products of history and ideology. Where would the field of computer music be without the largesse of the United States Defense Advanced Research Products Agency and multi-national corporations like Bell Labs? Do we have the right to forget this, to ignore the other ends to which this research has been employed? And what of Apple's labor practices? Microsoft's monopolistic aspirations? Intellectual property issues? Net neutrality?

If we bury our heads in the sand, like the ostrich of my title, we abdicate the right to call ourselves good citizens, good partners. I wonder, then, if we retain any criterion by which we can declare ourselves good artists? And besides, the very sands in which we would bury our heads are constantly shifting under the influence of the giant Chladni plate that is history. Those who, for the time being, succeed in burying their heads, are eventually exposed.

I propose the title, "The Chladni Ostrich," as an admonition, a cautionary metaphor, and finally, and most optimistically, as a red herring. It was Pliny the Elder, in his Natural History, published in the first century of the Common Era, who wrote of the ostrich:

> But the veriest fooles they be of all others. For as high as the rest of their bodie is, yet if they thrust their head and necke once into any shrub or bush, and get it hidden, they thinke then they are safe ynough, and that no man seeth them.

As it turns out, Pliny was wrong. Ostriches do not bury their heads in the sand or the bush or anywhere else. In fact, when threatened, ostriches can cause serious injury and death with kicks from their powerful legs. So, what follows is nothing more (and nothing less) than a vigorous, ostrich-like defense of the idea that we as artists have both the responsibility and the privilege of engaging the world in the spirit of a good partner.

My usage of the term "non-cochlear" is slightly different from that of the theme of this year's International Computer Music Conference. The title of my book is In The Blink Of An Ear: Toward A Non-

Cochlear Sonic Art. Nowhere do I speak about "non-cochlear sound." My interest is in sonic art practice and not sound-as-such. The idea of a non-cochlear sonic art is, of course, a rather blatant piggybacking on Marcel Duchamp's idea of a non-retinal visual art. When Duchamp coined this notion, he was thinking of a visual art practice that does not appeal primarily to the exigencies of the eye or to visual pleasure. Instead, he is indicating a practice that moves beyond the strict jurisdiction of the eye to a set of concerns that came to be known as "conceptual." I am suggesting a parallel in the sonic arts; an approach that moves beyond the exigencies of the ear, that reduces the value of sonic pleasure in favor of a broader set of philosophical, social, political, and historical concerns.

The term, "non-cochlear," attempts what I'm sure is a crude anatomical transposition, equating the cochlea with the retina. The point is not the biological equivalence of these apparatus of perception, but their metaphorical equivalence in the processes of reception. What I'm suggesting in not a sonic art without sound, but an art that reduces the importance of sound, in and of itself. To be more precise, I'm suggesting that there is no such thing as sound, in and of itself, and that sound is always both constituted by, and constitutive of, its cultural, historical, political, and economic context.

The past half-century has been the most productive and meaningful period in the history of the visual arts. I know that's a big claim. But the successive movements of Minimalism, Conceptualism, Institutional Critique, and social-based practices, have allowed art to transition from a source of pleasure to a source of critique and meaning-making. By encouraging a conceptual, non-cochlear sonic practice, I hope to allow sound and music to partake of these fecund tendencies in the visual arts; to acknowledge the mutually profound influence of sonic practice on culture and of culture on sonic practice. Sonic art should feel entitled to engage politics, economics, gender, the philosophies and institutions of the practice itself.

To that end, my book argues against the ineffability to which sound and music have always felt a privileged entitlement. The term "ineffable" is derived from the Latin effari, meaning "utterance." To be ineffable is to be unutterable, unspeakable, beyond the reach of mere words. As this ineffability would have it, music and sound escape what Frederic Jameson has called "the prison house of language." But if language is a kind of prison, this suggests that there is a freedom outside this prison; that if we were to bust out of the joint, we would discover a world unfettered by restriction, compromise, convention, or structure. This ineffable world would be uncorrupted, pure; uninvaded by the schismatic infection of language. So when sound and music stake a claim to ineffability, they also stake a claim to wholeness: either one that has somehow been preserved – Eden-like – against the incursive pollution of the real world; or one that has been reconstructed, after the Fall, as it once and always should have been.

The traditional defenders of music as bastion of the ineffable straddle a line that cannot, in fact, be straddled. This is the line that divides the transcendent from the sublime. The transcendent is mystical: its power comes from without – from a beyond to which we have no access and upon which we can exert no influence. The sublime, on the other hand – I'm updating Jean-François Lyotard here – is immanent, generated from within – by the psyche, by institutions, by history. I'm convinced that the power of the sonic arts is derived from the sublime, and not from the transcendent. This is not an argument of degrees – as if those who claim transcendence are experiencing something bigger, deeper, better than me. It is an argument of typology, at its core, of ontology, or (a term I'm considerably more comfortable with), of epistemology: of how we know what we know – whether that knowing is intellectual, emotional, social, or more than likely, a combination of all three and more.

I reject the transcendent as a condition of possibility. I do not accept that there are forces – whether they be consciousnesses, energies, wills, or intentions – beyond those that are part of our material relationship with the world. Our understanding of these forces is a matter of use value – a Marxian term, used here in a Heideggerian fashion. We understand these forces to the extent that we can make some use of them: intellectually, emotionally, socially. There are no forces such that we do not know or use them. Again, this is not so much an ontological claim, as an epistemological one. Bottom line: what makes you feel the way you do about the best thing you ever heard is a complex network of social, economic, historical, psychological, and cultural forces, all of which can be examined and, in the appropriately sensitive hands, described.

Of the various ways in which music and sonic art attach themselves to the transcendent, two, in particular, strike me as being so deeply entrenched that they have become much more than tendencies. They have become fundamental principles, articles of faith. I refer to these two tendencies as "Sound-in-Itselfism" and "The Transposition Fantasy." Together they underwrite the supposed value of an alarming percentage of contemporary sonic art. But these two attachments to the transcendent are

symptoms of a false sonic consciousness. Each projects a vision of imaginary wholeness, in which identity and meaning are self-evident, avoiding the unavoidable fact that identity and meaning are always endless processes; that nothing is self-evident. Identity and meaning are always a product of specific relations, under specific circumstances, at a particular place and time. If we can dissuade ourselves of notions of self-evidence and self-sufficiency, then the sonic arts will no longer have a justification for disavowing their partnership with the world.

Sound in-itselfism

As we all know, John Cage famously asked us to let sounds be themselves. Cage wanted us to listen in a state of pure reception, our analytic and judgmental apparatus suspended. His aim was to undermine the faculties of taste and subjectivity that had underwritten Western aesthetics since the late 18th century and Kant's Critique of Judgment. But, there are two problems with Cage's prescription. First, sounds can not be themselves. A sound is always, by definition, the result of an interaction between at least two materials: bow and string, air and membrane, stick and skin, water pitcher and tile floor, fist and face. Sound, to a greater extent than sight, is a coming together. Sound always includes an implicit versus; contact, communion, conflict. There is no in-itself. There is always an in-relation. Second, what Cage really wanted to change wasn't the status of sounds, but the behaviors of human listeners. Under the influence of D.T. Suzuki, Meister Eckhart, Joseph Campbell, Ananda Coomaraswamy, and a host of mystics from both Eastern and Western traditions, Cage championed a kind of disinterestedness. This was not disinterestedness in the strictly Kantian sense, but a letting go of pre-sentiments or predilections in order to lose oneself in phenomena, artistic or otherwise. Sound-in-itself then is not a definition of any given sound, but of the way one ought to hear it. That is, without preconception and without judgment. The danger of this – given that sound is always the result of an interaction between at least two materials – is that the listener becomes willfully ignorant of the contextual meaning of whatever he or she is hearing. What is lost is the very real and very meaningful social and political differences between the sound of bow on string and the sound of fist on face.

Francisco López likely needs no introduction here. He is a remarkably prolific maker of recordings and performances. Today I'll focus on his 2008 performance of a piece called Buildings (New York) at the Judson Church in New York. When he performs live, Francisco López is very particular about how the performance space is organized. To avoid the inevitable difference between the sound of stage monitors and the main-room PA system, and not wanting to cede control of the final sonic result to a sound engineer in charge of the live mix, he locates himself and his gear in the midst of the audience. He objects to making the performer the visual focal point of an electronic music performance. The audience is arranged around him in concentric circles, their backs turned to him, facing an array of speakers arranged along the perimeter of the space. He darkens the room and, to truly minimize the visual, obscures his panoply of gear under a dark fabric cloak. At a 2008 performance of his Buildings (New York), at the Judson Church in New York, López "strongly suggests" that each member of his audience wear a blindfold—supplied by López —for each performance. In the program notes, López states, "Every listener has to face his/her own freedom and thus create." The freedom López wants us to face is curiously compromised by his setup. Though situating himself in the center of the audience may alleviate the two-mix problem, this arrangement also insures that only López is entitled to hear the complete surround-sound mix. Every audience member is forced to occupy a compromised position in the sonic field, closer to one or two speakers than the rest.

More importantly, turning their backs on the performer puts the audience in an implicitly vulnerable position, akin to Jeremy Bentham's panoptic prison design, in which prisoners may be observed by a central warden while the warden himself is invisible to the prisoners. Michel Foucault famously saw the panopticon as a metaphor for the diverse institutions of modern disciplinary society, bent on observation and control. Donning blindfolds only exacerbates the instantiated power relation, creating a kind of pansonicon. At a performance just two miles from the site of the World Trade Center, in the midst of the U.S. War on Terror, in the wake of revelations of abuses at Abu Ghraib and at Guantanamo Bay—the whole scenario takes on sinister overtones. This is not to suggest that López intends to lord menacingly over his audience, but that he seems blissfully (if problematically) naive regarding the connotations of his extended text. López intends his sounds to be devoid of semiotic attachments to identifiable referents. As he states,

> I have a completely passional and transcendental conception of music. Of course, I have lots of ideas about the world and politics and whatever, but I think these things shouldn't contaminate, shouldn't pollute, the music. I'm very purist [1].

Only López's transcendental purity allows him to think he can keep the world and politics out of his work. But try as he might, he will fail. If one listener connects his choices to conditions in the world, then others will too. And even if they don't, López's work is irrefutably the product of social, historical, and economic situations that are particular to his time and place.

Take, Johannes Kreidler's Product Placements (2008), a 33 second composition, created from 70,200 samples. When Kreidler composed the piece, he telephoned GEMA, the German performance rights society, and requested the forms that are required to register the samples he employed. He then completed the forms – all 70,200 of them – and delivered them, with a truck and two assistants, to the GEMA office. Needless to say this is not sound-in-itself or sound-for-itself. There's very little itselfness at work here. There is no transcendent appeal to the mystical properties of music, no effort to transport the listener to a rarified place beyond the reach of worldly, quotidian concerns. The 33 seconds of sonic material act primarily to expose a set of practices, institutions, conventions, and regulations, plus the cultural and intellectual structures which make them possible. As Kreidler says,

> For me, music never exists alone; a composer must always deal with interrelationships. Music deals with technology and the politics of technology, with consumption behavior, and the cultural and economic value of art. These things play a role in my creative work; I use them as artistic material [2].

After composing the piece and filling out the required 70,200 GEMA forms, Kreidler alerted the press about when he would deliver the forms to GEMA. Kreidler challenged GEMA, who had been inundated with inquiries about how they would handle the piece, to hold a press conference to debate issues of intellectual property and bureaucratic control of copyright. The day before the delivery/performance, trying to stave off a public showdown, GEMA issued a statement, saying that not every little sample would need to be registered. This contradicts GEMA's own policy and the language of their registration forms. On the 12th of September 2008, Kreidler delivered the forms. You can watch the video on YouTube. It's an amazing piece of absurdist theater worthy of Beckett. Under pressure, GEMA finally arranged an eleventh hour press conference at their Berlin headquarters. In the end, GEMA and Kreidler reached an agreement that spared GEMA the difficulty of processing the 70,200 forms. Kreidler now uses the stacks of forms as a pedestal for a video installation documenting the delivery/performance.

Surely, Product Placements is an example of what Kant called the "mathematical sublime," something either so large or so small that we cannot properly comprehend it. In this case, it is both too large (the number of samples) and too small (the size of each sample). But, one could argue, it is also sublime in the Lyotardian sense, exposing the vastness and apparent immutability of the mindset that underwrites Modern, Western, capitalist notions of ownership, property, and authorship. These values seem natural to us, and not the products of historical events and evolution. But the only thing natural is that, as this very same history proceeds into the future, these values, as written into copyright law and our collective sense of personal property, will no longer make sense. The evolution of technology and aesthetics requires new conceptions of ownership and authorship. This is what Product Placements makes so plain. Institutions like GEMA come into being to maintain current societal values. One of the great services that art can provide is to destabilize these values, to expose them as constructed, and therefore as deconstructable and reconstructable.

The 'transposition' fantasy

The second symptom of sonic false consciousness, the transposition fantasy, is based on the belief that phenomena in one modality of sensory experience can be transposed to another. The fantasy insists that the transposition can reveal something true and real about the phenomenon in question, thereby enhancing our understanding of it. The most often cited example of this tendency is poet, Rainer Maria Rilke's fantasy of playing the coronal suture of the human skull with a phonograph needle. Rilke writes:

> What variety of lines, then, occurring anywhere, could one not put under the needle and try out? Is there any contour that one could not, in a sense, complete in this way and then experience it, as it makes itself felt, thus transformed, in another field of sense [3]?

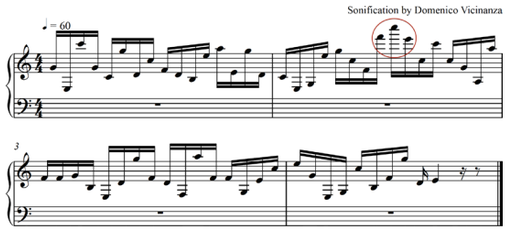
Rilke's fantasy announces the dream of a unified field of the senses, bridging "the abysses which divide the one order of sense experience from the other" and "completing," to use Rilke's verb, our experience of the world.

Steven Connor compares this urge for sonification to intelligent design: the erroneous belief that complex phenomena – such as sounds, human beings, volcanoes, forsythia – must be the manifestation of some "pre-existing blueprint." The implication is that both the intelligence, and the design, of the original phenomenon is not available –

or at least not fully available – to us. By transposing it to the sonic realm, somehow we can encounter and understand it more fully.

A more recent example of the transposition fantasy is a musical transcription of the Higgs Boson data collected at the Large Hadron Collider near Geneva.

Higgs Boson (ATLAS Preliminary data)



The three circled notes represent the bump in the data that indicates the presence of the Higgs. Now that we all understand what the Higgs Boson is and why it's important, let's move on.

As Connor points out, the transposition fantasy

> … lies in a mysticism of the primal, a set of beliefs that sees translation into sound as a kind of making manifest of the latent truths, of a set of absolute but hidden primal conditions [4].

The transposition fantasy imagines itself as a kind of unlocking of secrets, a liberation of meaning. It emerges from the false belief in a primordial stratum of experience; a wholeness, a great "it" from which all other, quotidian its derive.

Let's consider a recent example culled from the art world: Doug Aitken's 2009 piece, Sonic Pavilion, installed at Inhotim near Brumadinho, Brazil. The piece consists of a hole, twelve inches in diameter, and a mile deep, drilled into the earth. At the top of the hole, sits the eponymous pavilion, a circular glass structure. Visitors enter via a spiral ramp that ascends from the ground below the pavilion, emerging into the unfurnished space. The glass is covered with a lenticular film so that as you approach the glass, the periphery of your visual field is blurred out as in a cinematic depiction of a dream or a memory. A phalanx of microphones have been lowered into the hole at various heights. The signals captured by these mics are then transposed into the range of human hearing and amplified in the pavilion. Aitken, however, has declined to specify what computer-based transformations are employed. For instance, he will not say if the pitch transpositions are uniformly consistent, maintaining the frequency ratios of the sources, or if he has played with pitch relations in the manner of a composer.

The situation and design of the pavilion insist that there is something sacrosanct beneath the superficial stratum we occupy. The sound emanating from the hole and amplified in the pavilion is the cipher that will unlock the coded mystery of the deep. The Rilkean implication is that a phenomenal entity like the earth possesses essential properties that are consistently expressed across different sensory manifestations. It might be comforting to think that phenomena can be "solved" and that experience can be "completed" by filling in the blanks in our senses. But confronting the existential burden of knowing that experience inevitably evades completion would surely be more honest. Sonic Pavilion denies the visitor the privilege of assuming this burden, offering blissful ignorance – transcendence – in its place. In his promotional description of the project, Aitken writes that,

The work offers an opportunity to engage the inner workings of the earth in an unprecedented way… revealing the earth's mysterious and living dialogue.

But it does nothing of the sort. The pavilion obscures both the sources of its sounds and the specifics of their manipulation. It brings us no closer to understanding the earth, knowing what it really is. The problem lies in the implicit suggestion that Sonic Pavilion will "solve" the earth and "complete" our understanding of it. This is a classic case of the transposition fantasy which, in Steven Connor's words:

> prolongs a transcendent sound-obscurantism that gives sound studies much of its impetus while yet also enfeebling it intellectually [4].

At first, one might mistakenly think that Alvin Lucier's Music for Solo Performer from 1965 is falling down the same Rilkean rabbit hole as Aitken's pavilion. EEG electrodes attached to the performer's scalp detect bursts of alpha waves, in the range of 8 – 12 Hz, which are generated when the performer achieves a meditative, non-visual brain state. These alpha waves are amplified and the resulting electrical signal is used to vibrate percussion instruments distributed around the performance space. Lucier's piece does not transpose the brain's alpha waves into the range of human hearing. Rather, he uses the waves to stimulate percussion instruments. We're not listening to the performer's brain, we're listening to the performer's brain doing something, the same way we listen to a percussionist's hands and arms doing something in more traditional performance. The piece does not in any way suggest that it can bring us any closer to understanding the performer's brain. What's more – and this is indicative of what's so great about the best of Lucier's work – in order for the performer's brain to generate the

alpha waves, the performer has to do nothing. Alpha waves are generated only when the brain's visual cortex is idle. So, the performer must engage in an extremely unperformative kind of performance in order to perform Music for Solo Performer. The piece appeals to nothing transcendent. Brilliantly, it merely constructs a material chain from the brain's neural activity to vibrating membranes. In the process, however, Lucier generates an immanent critique of musical convention in the form of this absurdist performance.

Kreidler's, "Music for a Solo Western Man" from 2010, is a kind of remix of Lucier's "Music for Solo Performer." Kreidler asks a performer to execute Lucier's instructions, but to do so while listening to selected audio on a pair of headphones. First the performer listens to the music being performed at that very moment across town at the Berlin Philarmonic. Predictably it's Beethoven.

What we hear is not the performer's brain, but, as Kreidler notes, only the sonic equivalent of the shadow cast upon the cave wall in Plato's Republic, a faint, misleading, simulacra, that grants us no genuine access to its source. Next, the performer listens to the soundtrack of an X-rated film. Lastly and tragically, the performer listens to statistics related to the global financial crisis and the ensuing suicides of laid-off General Motors workers.

Kreidler's intervention inserts overt socio-economic material into Lucier's sly performative critique. In both pieces there is no taint of the transposition fantasy, nor of the underlying appeal to transcendence. While Aitken's Pavilion vaguely indicates an earthly realm that is mysterious and inaccessible, both Lucier's and Kreidler's works engage the worldly concerns of how we live and interact on the earth. Their music is part of the world and the world is part of it.

I wrote In The Blink of an Ear out of a sense of deep disappointment over the fact that music's mysticism could not be jettisoned, even in the wake of John Cage's 4' 33" – the event that, by all rights, should have placed worldly conceptualism at the center of sonic practice. If it had done so, music's turn would have concurred with similar moves in the visual arts, literature, film, and dance. Music and sound art could have dropped their sacrosanct separatism. The sonic arts could have joined the other arts, discarding media-specificity in favor of a cooperative embrace of all the sensory modalities and media tools available in the late 20th century. Like the other arts, sound art and music could have come to terms with their codependence on the forces of culture, history, economics, and politics.

Cage famously linked the inspiration for 4' 33" to seeing Robert Rauschenberg's all-white canvases in 1951. Cage said,

> when I saw those, I said, 'Oh yes, I must. Otherwise I'm lagging, otherwise music is lagging' [5].

Conclusion

So to conclude, let me move from what the sonic arts could have done to what we should have done and what we still ought to do. Just as Cage's mentor and friend Marcel Duchamp initiated a turn toward non-retinal visual art that has informed the most important art of the ensuing century, Cage's 4' 33" should have initiated a turn toward a non-cochlear sonic art. The sonic arts have steadfastly resisted this turn.

Yes, there are a few artists, a few composers, who have embraced conceptualism, engaged with issues of politics, economics, gender, history, philosophy, culture; who have interrogated their own practices and presumptions; who have subverted the conventions of sonic aesthetics. These practitioners are trying to be good partners to the world in which they and their works live. They are resisting the musical urge to turn their backs on their better halves. Yet, overall, the sonic arts still have a lot of catching up to do. 4' 33" did not do the trick. It is 2012, ninety-nine years since Duchamp's first readymade, and still, music is lagging.

REFERENCES

[1] Cox, C. "Abstract Concrete: Francisco López and the Ontology of Sound." In: Cabinet, No 2, 2001. (http://www.cabinetmagazine.org/issues/2/abstractconcrete.php Accessed 23 Jul 2012)

[2] Kreidler, J. "Gema-Aktion, Product Placements", 2008. (http://www.youtube.com/watch?v=EAptRZlwziA&feature=relmfu, 1:53. Accessed 23 July 2012.)

[3] Rilke, R.M. "Primal Sound" (1919), as quoted in: F. Kittler, Gramophone, Film, Typewriter. Translated by Geoffrey Winthrop-Young and Michael Wutz. Stanford: Stanford University Press, 1999.

[4] Connor, S. "Photophonics," Sound Effects: An Interdisciplinary Journal of Sound and Sound Experience, 3(1). 2013: 132-48.

[5] Cage, J, R. Shattuck, and A. Gillmor, "Erik Satie: A Conversation," Contact: A Journal of Contemporary Music, 25. 1982: 22.

ICMC 2013 Keynote Address, The place and meaning of *computing* in a sound relationship of man, machines, and environment

by Agostino Di Scipio
Given at State Theatre Center, Perth Western Australia, 11-17 August 2013

Abstract

The following text was prepared by the author for his keynote speech at the opening session of the International Computer Music Conference 2013 (12.08.2013 State Theatre Centre, Perth, Western Australia). It discusses the relationship between computing resources and the hybrid technological infrastructures necessary in sound- and music-making practices, as well as to the surrounding physical space where such practices take place. A brief historical survey is outlined of the subsequent connotations of computational tasks and their coupling (or decoupling) to the physical environment: from "calculation", to "communication", to "media processing", to today's "embedded (or physical or tangible) interfaces". In the latter case, a comprehensive view of the "performance ecosystem" seems generally useful to ponder the stronger and stronger integration of different agencies involved, together with a practice-based account situating the performer's (and listener's) body in this ecosystem. As an example, the author illustrates a sound installation work of his own, based on the structural coupling between the acoustics of a room environment and the technical equipment (computational resources, pro- and consumer-level electroacoustic transducers, and mechanical resonators). Albeit personal, the example hopefully illustrates broader artistic concerns and practices in which data from various sources in the environment are admitted as component parts of the computing process. It is suggested that a notion of "computing" seems to materialize here; one that can't be reduced to "information processing", and gets closer to a broader view of "embodied and situated cognition" rooted in the biology of cognition and the epistemology of living systems.

Introduction

Computing, and music computing in particular, is today going through a variety of changes and developments. I'd like to pick some of those that seem most relevant for current sound-making creative practices, particularly in light of the ICMC 2013 theme: "international developments in electroacoustics". My discussion moves from the very trivial observation that, in fact, one always needs analog electroacoustic equipment in order to turn digital signals into sound, and vice versa. More generally, in order to make sense of what in the world can be computed – provided there is anything really computable in music-related activities – one always needs non-digital as well as digital resources.

However, today the particular manner in which digital technologies are sided by, and integrated in, different but overlapping technological layers, seems to be increasingly significant to practitioners. This is clear from contemporary live performance practices, where computing devices typically do not stand alone, but are rather embedded in a larger "performance ecosystem" [1]. Here, other technological layers and agencies play an (equally?) important role, whether they are human agencies (performers), mechanical agencies (music instruments and various infrastructures), or devices ranging from basic analog gear to "software ecosystems" . More generally, what counts in this notion is the array of looser or tighter relations among the agents involved in the performance process, as well as their relationship to the physical space where the performance takes place. Significantly, a practice-led account becomes increasingly necessary to properly situate the performer's (and listener's) body in such approaches to musical performance [2].

One may ask: where does computing take place in such circumstances? What is its role within the larger infrastructures that are needed for any computer music to exist, and what is the role of the infrastructure components for any computing to actually take place? I think answers may vary depending on what we mean by "computing". Far from being timeless or universal, the term has taken on different connotations over the course of modern history.

Early connotations of "computing"

In early information theory and early cybernetics (first half of the 20th century), the computer existed first and foremost as a kind of refined and programmable "calculator", hosted in very peculiar installments that were mostly closed to the outside world - i.e. in the rather anodyne environment of mainframe computer centers. That was before (and after) the advent of "commercial computing", which historians date to the years 1945-1955 [3]. In that context, computing was largely understood as a tool necessary in mainstream academic research (and not only in the hard sciences: the "electronic brain" metaphor was quickly adopted in psychology and social sciences). The only exchange between the number-

crunching engines and the physical world was through the input/output channels necessary to instruct the machine to execute the requested tasks, and to observe the end results of the execution. The transition from mainframe computers to "minicomputers" (1960s), and then "personal computers" (late 1970s), preserved the connotation of advanced research and science, but it was not without a gradual but substantial shift, partly reflecting a new ideology of non-academic research (or at least, research freed from investments in mainstream science). With the era of "home computing" in the early 1980s, a shift in the way computing was represented and imagined took place. Due to the ease with which documents could be produced, and other office-related work activities accomplished (beside entertainment like computer games), the place of computing moved from "calculation" to "communication". The shift was complete in the 1990s with the coming of age of massive telecommunication networks and the popularization of the internet through the world-wide-web built on top of it. By way of its hidden number crunching, the computer became for most of us a device for homework and personal communication, and then eventually a terminal connecting to "social (digital) networks" (2000s). In other words, the computer became the "communication terminal" with which we have been familiar for the last two decades, and that today is being reinforced by "cloud computing" and "big data".

New connotations accompanied the more recent developments, though. One is a shift in which devices, still called "computers", are less "communication terminals" and more "media management centers", or "media processors" [4]. What is so peculiar in the latter idea is the notion of a kind of overarching media, a generalized instance of hypermedia, not aimed so much towards tasks of "mediation", but to tasks of "re-mediation" . Given the overwhelming amount of large-scale applications addressing massive audiences and accessing massive contents ("big data"), I tend to agree with this post-modernist account of the computer as enabling a reframing and a reenactment of contents previously belonging to separate media. However, and in contrast to the end-of-history idea it is too quickly associated with, I think that we should refrain from considering the postmodern account as reflecting the only and ultimate connotation of what computers may represent for us; at least not until creative, visionary artists and engineers engender an attitude of critical thinking about both what we do with our tools, as well as what we do of them (and that implies: of themselves artists and engineers).

Contrary to the notion that would have the current scenario flattened exclusively on the software level [5], I deem more relevant today a conception of software and digital media as integrated and rearranged across other technological layers and media that they cannot (re) mediate, and eventually strictly coupled with the physical space. A few years ago I read: "Now that computation's denial of physicality has gone as far as it can, it is time for the reclamation of [physical] space as a computation medium" [6].

Current "computing" connotations and research directions

Today, a relevant connoting potential lies in computing devices known as "microcontrollers", representing increasingly important components of everyday objects and sites. These allowing computation units to be packed into small to smaller circuit boards, with i/o channels connecting to the physical world (sensors, actuators and other transducers reaching into the environment). Sometimes we hear talks of "pervasive computing", or, more interestingly, "physical computing", which usually means that aspects of the environment are sensed by computer interfaces and drive ongoing computations, which in turn actuate changes in the environment. The dissemination of such computing units across artifacts and throughout the environment creates a network (or perhaps should we say a meshwork?) of mutually affecting processes and agencies. We are used to hearing about "tangible interfaces", or "physical interfaces", described as retaining and manipulating "referents" to real objects and spaces [7], and therefore offering a greater sensory richness and human significance than screen-based elements can afford [6]. Addressing the dynamics of "interaction" in contemporary digital music, [8] speak of "behavioral objects".

Such developments are part of an ongoing trend that can be seen to positively disrupt the previously encoded limits of computing. The CEOs of large corporations are increasingly employing the catchphrase "the internet of things" to describe physical computing, which confirms that the trend is opening up a potentially enormous market. Not surprisingly, occasions of a paradoxical triumphalism can be spotted: as far as music making and acoustic communications are concerned, this presents the risk of obscuring the more important cognitive and experiential phenomena involved in auditory experience and listening. I can't say whether it is a promise or a threat when, in a popular cookbook, a guru of physical computing shows us how to "create talking objects from anything" using "computers of all shapes and sizes" [9]. Will we survive a saturated acoustic semiosphere,

where anything can talk to us? And more to the point: what do we make of "talking", along the way?

Among the interesting creative efforts in the field of "audio physical computing", I'd like to mention the work of Andrea Valle, whose real-time "acoustic computer music" is made "by computational means, but (whose) sounds are generated from acoustic bodies" [10]. Some of his experimental projects present hybrid performance infrastructures, where acoustic or force feedback occurs across different technologies [11]. Equally relevant, albeit from a different perspective, is research work undertaken under the umbrella definition of "mechanical sound synthesis" [12] [13]. Of course, the latter perspective follows from elaborate physical modeling approaches, often targeted at "virtual" or "augmented reality" technologies. However, in such approaches I also see a potential for a stronger and more widely shared ecologically and physically ingrained awareness of what sound is and how we deal with it as human beings. In my personal view, issues surrounding "virtual reality" are today both scientifically and artistically less fruitful than a higher awareness of real world, situated and embodied perception and action.

Structural coupling and position

Our admittedly too short survey, then, ends up with four subsequent but often overlapping connotations of computing: "calculation", "communication", "media processing", and "embedded (or physical) interfaces". We can observe a displacement of computing devices as relative to the specific context in which they are set to work. Of course, with the move from mainframe computer rooms to wearable microcontrollers a lot has changed. But for the purposes of my discussion, let's keep to the following two points:

(1) *The potential complexity and richness in creative designs and projects increases as a larger and larger set of data streams (coming from different sources in the environment) is admitted to, and is coordinated to be part of, the computing process.* Digital computing is of course done in digital devices, according to any number of algorithms and programming styles, but the array of connections-to and dependencies-on non-digital signals and non-software events has become so large today as to make it difficult to consider these latter sources as mere "input data". That is, as something "external" that gets fed into and independent number-crunching process. What we see, here is a gradual move to a style of computation that does not so much take input from the environment as is coupled with the environment. At a meta-level, we can describe this process as a "structural coupling" of (so-called) internal computations and (so-called) external physical conditions. In such a situation, computing becomes neither an entirely deterministic process, nor an indeterministic one, but an active part of a larger complex system. It yields less into "resultant" output data, and more into "emergent" patterns or behaviors.

(2) *As the relationship of the computing equipment to the surrounding environment changes, so too does our position in the environment as relative to the computing equipment.* (It has not happened by chance that, more and more often, people using computers in their music performances prefer not to stand or sit before the computer screen, but rather focus on other centers of attention and activities.) In my admittedly too short survey, "computer musicians" started out by standing or sitting inside mainframe computer installments (figure 1); here, all that occurred used to take place in the form of coded instructions coming from, and passing across, i/o channels (e.g. punch cards), and was accurately delivered in symbolic form by highly specialized personnel. We began, first, by sitting before the computer - or its monitor screen (figure 2). And we ended, later on, by moving around the room and across the streets, with networked computing, microcontroller interfaces, "cloud computing", etc. (figure 3). In other words, musicians using computer resources literally moved from within an environment made of computer hardware parts (where computing literally environs, surrounds, and envelopes us) to an environment hosting one ore more computer stations. And finally, we moved to an environment where computing units are spread all around, absorbed into many of the objects and surfaces that make up the environment itself.

At this point, some words are necessary concerning the notion of "environment", as I have left it rather undetermined so far. Following the ecological and biological sciences, we should consider "environment" not as the generic surrounding physical space, but as a segment or selection of forces and agencies in that space, and which are meaningful to the functionality of the system under consideration. The environment is the particular section or "niche" of the physical world, which "unfolds in relation" to the living beings inhabiting that niche [14].

Because human beings are able to shape their environment, today they seem to be shaping for themselves environments that have calculative capabilities. On the other hand, what counts as "environment" for devices such as microcontrollers and computer interfaces is a limited set of selected features, or properties, in the physical space. (For example, the

"home" of "home computers" may be an "environment" to us, but it is not to the computer, despite the fact that many of the the functionalities expected of a "home" are necessary for the computer to work.) By purposefully specifying the features in the physical space that are sensed and acted upon by our computer interfaces, we specify what counts as "environment" to these devices. By purposefully specifying the possible interactions between devices in the environment (figure 4), we are defining a potential "ecosystem" - a web of interacting forces whose global behavior is brought about by local exchanges of energy (sound) and information (environmental traces taken on, and carried by, sound).

This brings us to a position from which, I think, we can better tackle the questions posed at the beginning of this paper. However, before we go back there, I'd like to briefly describe one of my own works that reflects - albeit in a very personal manner - some of the issues we are dealing with.

An example from my own work

Condotte Pubbliche (public conducts) is an "ecosystemic sound construction" that requires two small microphones and two earpieces (earphones, i.e. "small speakers"), all secured inside two brass pipes (strong mechanical resonators) which in turn lie on two standard near-field speakers sitting on ground (figure 5). It also utilizes a condenser microphone hanging from above, and a piezo disc lying on the floor (if the floor surface is in wood).

All transducers are bridged among them via an audio interface and some self-authored signal processing software, in such a way as to create a multiple feedback delay network (figure 6). Based on room noise, sounds are born of the local feedback conditions (Larsen tones) inside the pipes and across the surrounding room. The computer runs simple processing methods to automatically adjust gain levels. It also runs basic signal transformations, in ways regulated by constant adaptation to properties "observed in" (or "information extracted from", if you prefer) the total room sound. To the latter end, real-time signal-level descriptors are used to modulate the variables of signal processing transformations in a self-regulating manner. Besides background noise, and any noise events eventually caused by the visitors, the "room sound" includes the sound delivered by the setup itself: no clear distinction is made between the "system's own" voice and the sounds "foreign" to it. We thus have a larger system that, by definition, includes the acoustic space in its processes. In the real-time process, everything that can effectively generate, filter, and channel sound has some influence on the sonorities emerging in the feedback network, as well as on the temporal unfolding of the continuing sound flow. The approach is defined "ecosystemic" in the sense that all compositional designs and empirical adjustments are necessarily addressed both to "system" (gathering of objects and functions) and "oikos" (the host space). Or, more precisely, they are addressed to their permanent exchange and relationship: their "structural coupling". The task of composition therefore becomes one of "composing the interactions" [15] [16].

In principle, the process thus implemented should be able to unfold by regulating its own behavior, non-supervised, and exhibiting some level of systemic autonomy (i.e. self-regulating behavior, self-determination) . For this to happen, the system loops back onto itself through the environment: we can say that some level of "autonomy" (systemic closure) can only be achieved by way of a continuing openness, and some degree of "heteronomy" (systemic openness).
Figure 7 is an image of the *Condotte Pubbliche* first realization. Here you see a dark blanket hiding the speakers and the computer equipment beneath. But its function is also one of causing diffractions in the sound waves transferring from the two speakers into the pipes, and into the microphones sitting in the pipes. Everything in the piece has a sound-related function.

This work was born as an installation project, but I eventually devised ways to use it in performance contexts. Indeed, a performer can locate spots and surfaces in the complete setup that lend themselves to be efficiently acted upon, searching the affordances that allow for possible gestures, and for actions enabling her/him to enter the sonic process and play a role in it. One can act, for instance, close to the pipe ends or against them, using either mouth or hands. The aim would be to explore system behaviors that could not be manifest were the piece running unattended. This turns the "installation" into a kind of "instrument", or better, a sound generating device that includes the environment as a part of it - the same environment in which the performer acts as part of the sound generation process. The form of presentation therefore becomes uncertain: is it an installation or a performance? Or is it an instrument to play with? This is the kind of ambiguity that, in past decades, has characterized the work of such illustrious electronic music pioneers as Alvin Lucier and David Tudor, of course. Is the artistic content to be found in the sound atmosphere the work creates, or in the process that are running? I will leave such questions there.

In any case, performers will find themselves in a situation where they have to permanently negotiate their own freedom of action within the global behavior of the autonomous ecosystemic process. It becomes a question of taking part in a situation, maybe setting aside one's own wanted actions. What a performer does here is not a matter of "interacting with a computer"; neither is it looking for a specific, stipulated output sound. S/he is but a part of a whole network, made of mechanical, analog and digital components, each leaving its own trails behind, that might become audible or might just remain silent and unspoken. In a sense, the performer becomes another component of what counts as "environment" to the technical setup. S/he represents another source of sound and another source of (self) regulation - another agency, surely a particularly sensible and intelligent one, but also a fragile one. S/he cannot "direct" or "lead" the system. One can say that the equipment acts onto itself through the performer. Or, if you prefer, the performer acts onto her/himself through the environment and the computer. It is a matter of where you start reading the process. Each gesture on the performer's side enters a continuous flow of mutually affecting event streams - sonically revealing a veritable "ecology of actions" (to use a definition by the epistemologist Edgar Morin). As is typical in systems exhibiting "distributed causation", it is difficult if not impossible to say what is the very source to this or that event of sound, as the particular causes may be so deeply disseminated across the history of previous and current sonic interactions. Performing therefore becomes a question of "listening, and taking action". It also becomes a question of taking and releasing control. In our overly digitized world, this "taking and releasing control" is significant, in my mind at least, to issues of subjectivity and intersubjectivity; identity and transformation; self and non-self: issues that are the flesh and bones of our daily life. What is to be heard consists mostly of the audible traces left behind by the dynamical relationship of components sharing the same place and the same time, keeping and losing control over one another's actions.

Computing and composing: conclusions

What is the place of computing in *Condotte Pubbliche*? Sure, we have a very important software component, executing (on a standard notebook) a variety of digital signal processing algorithms (implemented with Pure Data or Kyma). This cannot be set aside. However, the software component alone can hardly account for the kind of system dynamics, nor for the audible traces it leaves behind. It's rather the tight but time-changing interconnections of the different component layers that are responsible. We have a small infrastructure of interlaced technological layers, each contributing to the entire process in its own way. For example, the earpieces (with their limited frequency and dynamics responses) and the pipes (with their specific acoustics) are surely responsible for characteristic spectral colorations. Many small nuances, and the overall system's acoustic efficiency, largely depend on the room acoustics and the characteristics of the particular transducers involved. Besides, to sonically exist, the piece needs a real space; a room, perhaps, to be inhabited rather than merely "occupied". An area in which different process trails and sound traces entangle, so as to form the "environment" to the work. It needs the background noise, or any other acoustic perturbation in a socially enlivened room. In this regard, Condotte Pubbliche comes close to the third of my Audible Ecosystemics, the 2005 solo performance Background Noise Study [17] [18].

Let's now enlarge the perspective again, and shift from my personal efforts to a broader view. What is the place of computing resources in music-making practices where those resources are coupled to the environment via overlapping, hybrid technical infrastructures? What is the precise function of computational activities, once they are heterogeneously and heteronomically driven, and maybe dispersed in objects and appliances scattered across the environment? I see a possible connection, here, to a much broader view once put forth by cybernetic pioneer Heinz von Foerster, who used to explain the Latin term "computare" (computing) as meaning "to consider or to contemplate things together" [19]. In this view, "computing" means "handling mutual relationships". Today, with our ubiquitous microcontrollers and apps, computing is indeed less "information processing" and more "coordinating the interconnections of disparate agencies".

This is all very general and admittedly too broad. Yet, if I may dare, my recourse to von Foerster is because, in the end, "composition" itself means "putting things together (Latin "componere", Greek "synthesis"). There is a similar notion of "caring for the interactional dynamics among different component parts". In creative explorations where computing units are interfaced with non-digital devices in an overriding set of ecosystemic dynamics, computing can be said to take place across the tripolar, recursive relationship of equipment, environments, and human beings. The relationship is recursive in the sense that it consists in a dense vector of mutual influences among component parts, which makes it impossible to separate input and output, cause and effect. Here, computing

is no longer the implementation of i/o functions: all output is input (and vice versa), all effect is cause (and vice versa).

In the way I am using it here, however, the qualification "recursive" also suggests something else. At any specific time, the current system state is the achievement brought about throughout the history of all previous states: the ecosystem process always operates in the here-and-now, and the complete sequence of past exchanges and interactions de facto set the conditions to current operations. It is a flux, a line of events, not a step-wise process: our softwares may work based on symbolic representations of time and punctuated, discrete events, and yet that would still remain within the operation of just one technological layer, and not that of the whole computing unit. Once set on the run, the man-machine-environment relationship unfolds in time as a kind of narrative, reflecting the actualization of past events in the configuration of the present. Beside, current emergent behavior may bind the potential of future patterns, and even prevent or submerge possible system states (a token of "downward causation"). In that sense, the process may reveal overall orientations and directions that are not stipulated.

In interdisciplinary work at the border between computer science, philosophy and post-computational cognitive science [20] [21], such features would be considered typical of living systems, i.e. systems whose activity is largely directed towards maintaining and transforming themselves by way of their permanent exchange with the segment of physical space that counts as environment. There, "computing" is equaled to "cognizing", and becomes a question of lived stories feeding back and forth across and through layers of different physical substances; none of which is digital, except perhaps for the threshold logics of the single neuron!

If we regard music as audible phenomena brought forth in a sound recursive relationship of man, machines, and environment, then the place of "computing" in "music computing" is nowhere and everywhere along the trails and paths: it's more in the way things connect among them, than in the things connected; more in the lines than in the nodes. And in the very way in which we stand and dwell in the environment.

Acknowledgments

Thanks to Cat Hope and her colleagues at Edith Cowan University, Perth.

Thanks to Scott McLaughlin for revising the first draft of the present text, and especially to Christopher Haworth for further improvements.

Notes

1. The debate on this issue was initially raised, a.o., in [22]. It mirrored broader philosophical questions often disputed at that time and in earlier decades e.g. [23].

2. The notion of "software ecosystem" has come to mean "networks of mutually coordinated software applications". While it lends itself well to software analysis issues [24], it remains merely and loosely metaphoric and has raised criticism. Richard Stallman considers it an entirely faulty if dangerous metaphor, because it conveys the view that artifacts - such as human-made networks, and even social networks - can be as void of implications of "intentionality" and "ethics" as natural ecosystems are [25].

3. That is, the mediation of other media, the processing and reframing of contents produced in other media, either older or newer ones, maybe designed specifically to be remediated [26].

4. According to anthropologist Tim Ingold, by insistently speaking of "networks" we end up experiencing the world in terms of a grid of "interconnected points", although the lived experience of our multifaceted relationship to the world is, in his terms, more like "interwoven lines" [14]. In other words, the "lines" (how we move from one point to another) are more central in our dwelling in the world: a metaphor of finely-threaded lines - such as the "meshwork" - should be preferred.

5. As of summer 2013, Intel corporation is making agreements with the microcontroller company, Arduino, to release Galileo, a small-size "Arduino-friendly" board designed to lead innovative "embedded interactive" designs. The project adopts Arduino's open-source ("we will learn from you", said the Intel chief executive to Arduino's father, Massimo Banzi, as they announced the collaboration; see [27]). This move could also be seen to rival the popular Raspberry Pi, a microcontroller device currently popular among computer music research projects (see various contributions to the ICMC 2013).

6. This was made clear, even before Gibson's ecological approach on perception [28], in pioneering research by Jacob von Uexküll in the 1930s, with his notion of Umwelt [29].

7. We usually conceptualize perception as a matter of poking information in the environment (so we may turn it into a task of "information processing", as in various styles of reductionist cognitive science). However, what we call "information" is not something of, nor in, the environment: "information" is inferences our body

builds upon data gathered by sense descriptors (system terminals) in order for us to define what counts as "environment" in physical space. In fact, "the environment contains no information; the environment is as it is" [30].

8. "Autonomy" is often taken as a self-explanatory notion, but closer analysis and attempts to formalise it are at an early stage. In the context of music-generating systems, see the introductory discussion of [31].

9. The DSP methods involved in the Audible Ecosystemic series of work (2002-2005) are more demanding and computationally expensive than Condotte Pubbliche. I have developed them on the Kyma workstation, which includes its own dedicated number-crunching hardware.

10. Two examples I came across recently are O.Bown and M.Young's performance Chatter Boxes and Raspberry PI Orchestra (2013), and SkypeBack, an extension of my Feedback Study (2004) recently proposed by Kevin Hay and Tam Treanor in Glasgow, as part of a BYOB "Bring Your Own Beamer" collective performance (2012).

References

[1] Waters, S. (ed.), Performance Ecosystems. Special issue of Organised Sound, 16(2), 2011.

[2] Green, O. User Serviceable Parts: Practice, Technology, Sociality and Method in Live Electronic Musicking, Ph.D Thesis, Electroacoustic Music City University London, 2013.

[3] Ceruzzi, P. History of Modern Computing, MIT Press, Cambridge MA., 2003.

[4] Manovich, L. The Language of New Media, MIT Press, Cambridge MA., 2001.

[5] Manovich, L. Software takes Command, Bloomsbury Academic, 2013.

[6] Greenwold, S. Spatial Computing, MIT thesis diss., 2003 (http://acg.media.mit.edu/people/simong/).

[7] Papadimatos, P. Physical Computing Using everyday objects as Communication tools, University of London, 2005.

[8] Bown, O., A. Eldridge, & J. McCormack, "Understanding Interaction in Contemporary Digital Music: from Instruments to Behavioural Objects", Organised Sound, 14(2), 2009.

[9] Igoe, T. Making Things Talk. Practical Methods for Connecting Physical Objects, O'Reilly Media, 2007.

[10] Valle, A. "Audio Physical Computing", Proceedings of the Sound and Music Computing Conference, 2011.

[11] D. Sanfilippo, & A. Valle, "Feedback Systems: An Analytical Framework", Computer Music Journal, 37(2), 2013.

[12] Berdahl, E., J.O. Smith III, & G. Niemeyer, Feedback Control of Acoustic Musical Instruments, CCRMA Report n.120, Stanford University, 2008.

[13] Berdahl, E., J.O. Smith III, & G. Niemeyer, "Mechanical Sound Synthesis and the new Application of Force-Feedback Teleoperation of Acoustic Musical Instruments", Proceedings of 13th International Conference on Digital Audio Effects (DAFx-10), Graz, 2010.

[14] Ingold, T. Being alive: Essays on Movement, Knowledge and Description, Routledge, London, 2011.

[15] Di Scipio, A. "Sound is the Interface. From Interactive to Ecosystemic Signal Processing", Organised Sound, 8(3), 2003.

[16] Anderson, C. "Dynamic Networks of Sonic Interactions: An Interview with Agostino Di Scipio", Computer Music Journal, 29(3), 2005.

[17] Meric, R. "Le bruit de fond est-il un son? À propos d'Écosystèmes audibles 3a d'Agostino Di Scipio", Filigrane, 7, 2008.

[18] Di Scipio, A. "Listening to Yourself through the Otherself. On Background Noise Study and Other Works", Organised Sound, 16(2), 2011.

[19] Foerster, H. von "On Constructing a Reality", in Environmental Design Research (F. E. Preiser, ed.), Dowden, Hutchinson & Ross, Stroudberg, 1973. Reprinted in Heinz von Foerster, Understanding Understanding, Springer, New York, 2003.

[20] Varela, F.J., E. Thompson, & E. Rosch, The Embodied Mind. Cognitive Science and Human Experience, MIT Press, Cambridge, MA., 1991.

[21] Winograd, T. & F. Flores, Understanding Computers and Cognition. A new Foundation for Design, Addison-Wesley, Reading, MA., 1987.

[22] Balaban, M., K.Ebcioglu, & O.Laske, Understanding Music with AI: Perspectives on Music Cognition, MIT Press, 1992.

[23] Dreyfus, H.L. What computers still can't do, MIT Press, Cambridge MA., 1994.

[24] Lungu, M. Reverse Engineering

Software Ecosystems. PhD thesis, University of Lugano, 2009.

[25] Stallman, R. M. "Words to Avoid (or Use with Care) Because They Are Loaded or Confusing", (http://www.gnu.org/philosophy/words-to-avoid.en.html Last Accessed 21 July 2014)

[26] Bolter, J.D., & R. Grusin. Remediation: Understanding New Media, MIT Press, Cambridge MA., 1999.

[27] Clarke, L. Wired.co.uk, Condé Nast UK, 03 October 2013, (http://www.wired.co.uk/news/archive/2013-10/03/intel-arduino-galileo, Accessed 28 July 2014)

[28] Gibson, J. J.The Ecological Approach to Visual Perception, Houghton Mifflin, Boston, MA., 1979.

[29] Uexküll, J. von "A stroll through the worlds of animals and men: a picture book of invisible Worlds", Semiotica89(4), 1992 [original publication 1934]

[30] Foerster, H. von "Notes on an Epistemology for Living Things", lecture presentation at the international conference L'Unite de l'homme: invariants biologiques et universaux culturels, Royaumont,1972. Reprinted in Heinz von Foerster, Understanding Understanding, Springer, New York, 2003.

[31] Bown, O. & A. Martin, "Autonomy in Music-Generating Systems", Association for the Advancements of Artificial Intelligence, 2012.

FIGURES

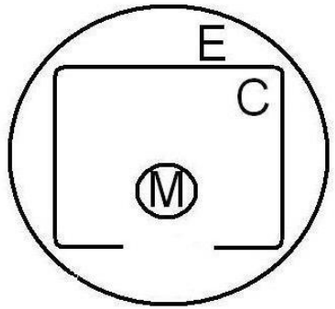


Figure 1. In figures 1-4, E stands for Environment, C for Computer, M for human being(s).

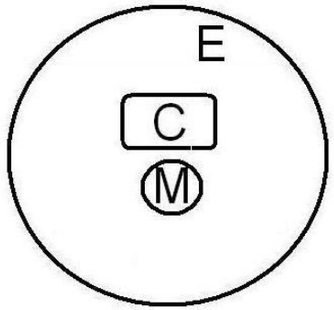


Figure 2.

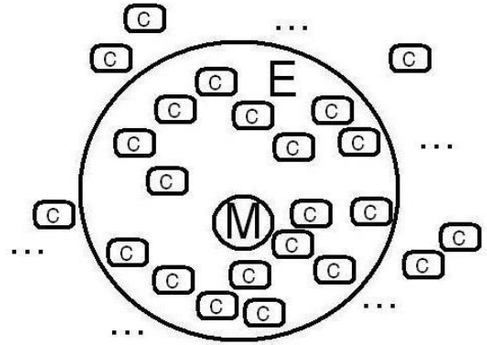


Figure 3.

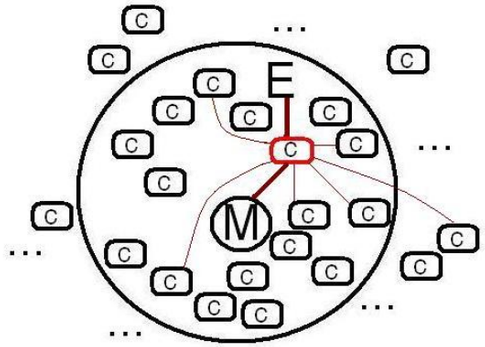


Figure 4.

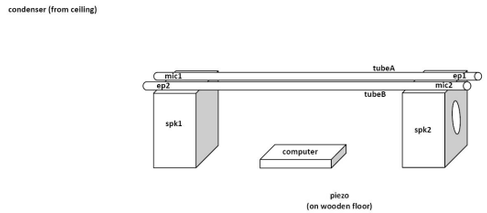


Figure 5. *Condotte Pubbliche.* Schematics of technical setup.

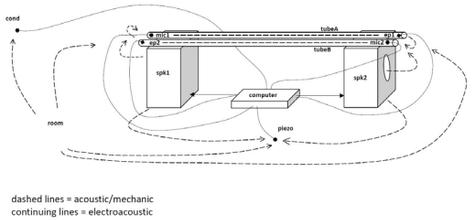


Figure 6. *Condotte Pubbliche.* Schematics of acoustic connections (dashedlines) and electroacoustic (continuing lines) connections.

Figure 7. Partial view of *Condotte Pubbliche* (Galerie Mario Mazzoli, PotzdamerStrasse, Berlin, March-May 2011).

An interview with previous ICMC hosts

Miha Ciglar, Cat Hope and Michael Clarke*

Array: Christopher Haworth and Scott McLaughlin

Array: What is required of an institution to host an ICMC?

M.Clarke: Hosting an ICMC is complex and does require significant resources. We first thought about staging it in Huddersfield in the mid 1990s but eventually decided we didn't have the resources at that time. By 2009, when we were again asked to consider bidding for the conference, we had a new building, many more staff working in computer music, and a University keen to encourage such ventures. Certainly fifteen years earlier we would not have been in the position to stage the sort of conference we did in 2011.

It is a large conference, often with 300 or more delegates, but it is also a kind of festival. Furthermore the music, and sometimes other aspects of the conference, often involves complex technical arrangements. All this implies a lot of spaces - halls for concerts (of suitable size, acoustic etc.), spaces for installations, listening rooms and demos as well as rooms for papers sessions, posters etc. With several concerts a day and the rehearsal demands of technically complex music there really need to be several concert venues (we had 3) all with their own sound systems, technical teams etc.

Although the delegate fees cover many of the costs of staging a conference (the music makes it particularly expensive), in my experience they are unlikely to cover the full costs of the very substantial administrative work and planning over many months. This therefore has to be covered either by external sponsorship, internal financial support, people donating their time freely, or some combination of these. We were fortunate to receive very generous support from our University.

Another key factor is having a dedicated team prepared and able to go beyond the call of duty. For ICMC 2011 I was very fortunate to have such colleagues. The Music and Paper chairs did an extraordinary amount of work as did our paid administrative assistants and the numerous volunteers.

But I hope I am not putting others off staging an ICMC - it really is great to do and brings many benefits. It is an important service to our computer music community too. And it would also be a pity if only large and experienced institutions felt able to stage it - part of ICMC's role I feel sure is to take computer music to new parts of the world to engage new regions.

M.Ciglar: First of all the hosting institution should have interest in the field of computer music. This means that it should in a way be engaged in research and development of audio technologies, it should be developing artistic projects and productions, and, if possible also conducting educational programs. IRZU – the host of ICMC2012 had all this but it did not have/own any infrastructure. The venues we needed for hosting the ICMC were contributed by our local partners (concert-halls, theaters, galleries, etc.) It is not difficult to create a local network of co-producers and venue-partners. It is a logistical task. Much more important is to have an idea what to do content-wise, and how to effectively merge the local context and history (concerning the hosting institution, as well as a broader local community of computer music practitioners) with the inputs delivered by the international community around ICMC.

C.Hope: (Hosting an ICMC requires) good partners. Whilst we are in a university, the support they could offer was limited, and the timing of the conference meant we did not have access to their facilities. So we had to find venues, and additional funds. You also need tenacity and the ability to 'sell' ICMC as a valuable event worthy of sponsorship. And of course, you need to know where to look for funding. Also, on a more pragmatic level, you need very, very good technical support.

Array: How do you see the crossover between scientific and artistic research at ICMC? Is there always scope for both to co-exist, or is that tension an important aspect of computer music in general (the tension of "research" in two different paradigms)?

M.Clarke: For me one of the key things about the ICMC has always been that it brings together musicians and scientists (and many subcategories of each of these!) The conference is at its best when these many diverse groups interact. It is a real opportunity for these communities to learn from each other and inspire one another. Something I tried to encourage when I was ICMA Music Co-ordinator (2000-2004) was more activity that crossed the boundaries, such as piece and paper categories, round-table discussions between composers and the people who create the technologies they were using. I'm not really sure I succeeded very much

** Qs 3 & 4 were not posed to M.Clarke.*

in that at the time but I am pleased to see some of these things happening now.

M.Ciglar: I always see the scientific part of the "computer music" field as a kind of an extended Solfeggio or music theory. It is crucial for both the scientific and artistic research practice to co-exist and cross-fertilize each other. In practice however, computer music composers seem to be very busy with writing etudes. In a way, it is a normal phenomenon, because as music-technology advances, the musical language is continuously expanding. Technology now offers so many expression possibilities that artists/composers sometimes forget what exactly it was that they wanted to express.

C.Hope: I think it's important to acknowledge the ongoing changing landscape for computers in music generally, and computer music in academia. Both scientific and artistic research can and should be represented at ICMC, by constructing appropriate streams for papers, but also different forums for presentation; workshops, piece and papers, concerts, installations, posters etc.

Array: The last two ICMCs represented something of a departure from previous conferences. The 2012 event in Slovenia foregrounded 'non-cochlear sound', a reference to Seth Kim Cohen's 2009 book, "In the Blink of an Ear: Toward a Non-Cochlear Sonic Art", whilst the 2013 in Australia featured composers of popular electronica (Haco) and writers on sound art (David Toop) amongst its keynote speakers. Can you talk about your intentions in choosing to bring ICMC into closer relation to sonic art and electronica? Did it lend a different character to the conference? I ask because, in this issue, Seth Kim Cohen (keynote of ICMC 2012) expresses some trepidation at bringing his perspective as a sound artist and critic to bear on the computer music community, fearing that what he has to say may fall on "deaf, or even antagonistic ears"…

M.Ciglar: ICMC2012 was not framed in terms of sonic art. Much more, it was framed in the context of "non-cochlearity". Johannes Kreidler, one of our invited composers, presented a concert piece, "Fremdarbeit", for a quintet ensemble of acoustic instruments, sampler and moderator. Kreidler's work is still one of the best examples of non-cochlear music. But the main aim of framing ICMC2012 in terms of non-cochlearity was to trigger some rather ontological discussions about the artistic practice within computer music, which of course is always a bit dangerous as it might question the importance of a lifetime-work and achievement of individuals.

Unfortunately, the theme was not really picked up at the ICMC2012. I think that in the end there were 1 or 2 submissions out of 600 that actually referred to the theme. And about 6 submissions which tried to refer to it but got it kind of wrong as they thought we were looking for tactile sound, sound visualisations, etc.

As for the event itself, I honestly did not have much time for informal discussions, since I was busy with logistics. All I can say is that the immediate responses to Kim-Cohens keynote were not very positive. It was not really surprising. It is difficult to open that kind of discussion within a keynote format. You could really see that the audience wanted to respond and open a discussion, but the schedule was just too tight. Perhaps it would be better to choose a different format, like a workshop or roundtable. Still it was very inspiring to have two keynotes on that topic sharing the same stage. Diedrich Diederichsen also had a brilliant presentation but, unlike Kim-Cohen, Diederichsen did not leave a space for the audience to feel offended. Altogether it was an unusual ICMC. Diederichsen and Kim-Cohen are not part of the ICMC community and all the time I felt a bit like I had flown 2 special unit G.I.'s into a war-zone to do their quick keynote operation and get out before they get them. I do not know how it felt for them and for the ICMC community, and I can't really tell if it made any sense to do this, but perhaps we could spark some new ideas in a few young composers' minds by choosing this topic. We will see what the next ICMC's will bring.

C.Hope: As I suggested in my earlier answer, computer music is always changing. For organisations like ICMA and their local affiliates to stay alive, we need to adapt to the changing face of computer music – where people learn it, where they make it, who makes it, where they find the equipment they need. Computer music is now being made by a wide range of practitioners, many who have never been to university, and who distribute their music or software through a range of different channels. I think ICMA needs to reach out to those people: show them ICMA are interested in what they are doing and how. It's good for everyone. I think ICMA should be for the computer music community in a broad sense. Many academic courses for computer music now embrace popular music/electronica – and are developing new technologies and ideas within those realms.

Array: Array has a history of focusing on gender inequality and discrimination in computer music. Having reviewed all the submissions to a recent ICMC, you may have some empirical insights to share on this issue. Do things seem to be

changing from your perspective (for better or worse)? It is a big question, but in what ways do you think ICMC conferences can contribute to encouraging more gender diversity in computer music?

C.Hope: We made a concerted effort to include at least one female keynote, as well as embrace the region somewhat. ICMCA were great in assisting us to find women reviewers too, so there was some chance of a balance there in a blind peer review process. But still, there was a very low percentage of women in the mix of accepted papers. More in works, but still much, much less than men. I think the situation for women in music generally has actually gone a bit backwards: as if we all got comfy since 'feminism is over' and have been acting as though there is nothing left to do to encourage women in music. In Australia, whilst around 25% of composers are women, only 6% of music programming features women's works (Australia Council report, 2013). So obviously – there is still work to do.

M.Ciglar: I only have insight in the 2012 submissions, not into earlier or later ones. In general the submissions (artistic as well as scientific) by female authors are rather scarce. We have the same problem in arts and science in general. As one of the dominant electronic/computer music platforms, ICMC certainly has the potential to encourage gender diversity in this field. However, the problem with gender inequality goes deeper and cannot really be solved at the highest level that an academic conference represents. ICMC is an exclusive venue. In practice, it requires a research position in academia in order to get access to ICMC.

Array: The music technology landscape has changed a vast amount over the last decade. Given the rise of other conferences in the same space, such as EMS/SEAMUS/NIME, do you think there is still a need for a "computer music conference"? What is the relevance of ICMC today, and how do you see it changing in response to the landscape? What future directions do you think might be fruitful for ICMC?

M.Clarke. For the reasons mentioned earlier I think ICMC still has a vital role to play. Other conferences do very important work in specific, focused areas but there is also a vital role for ICMC in bringing together a broad range of work in the field. I think we do all benefit from that. There has been a drop in the number of papers submitted to icmc in recent years, especially in some scientific areas, perhaps because of the proliferation of opportunities for people to publish. Perhaps we need to think seriously how better to attract people in these areas and how to communicate what it is that ICMC has to offer them.

The field continues to evolve at a rapid pace, both in terms of technological development and creative approach. If I am right in seeing ICMC's strength being its gathering together of all these strands it will need to continue to adapt imaginatively as the discipline transforms and embrace the full range of new work in the area. I would like to see future ICMCs continue to explore new ways of getting these varied communities to talk together and exchange ideas, not simply present different areas of work alongside each other. Perhaps one of the most difficult things is to do this while still attracting specialists in each area. But if it can achieve this I feel sure the ICMC will continue to play a major role in the discipline and be an exciting event to attend.

M.Ciglar: ICMC is one of the oldest academic venues for music and technology. I do not think that its name "computer music" nowadays is still understood literally. ICMC covers a very broad spectrum of work and it is very natural that throughout the years other conferences appeared, which specialized in certain sub-disciplines (artistic and scientific) of music and technology. The problem with ICMC as I see it, is that it is a rather hermetic and exclusive event, with a surprisingly stable and slowly evolving international community. Perhaps this is normal for an academic conference, but still, the contents that are presented at the ICMC are also present outside of academia. There is a vibrant and dynamic scene out there that is often not even aware of the existence of the ICMC. Perhaps it would be interesting as well as beneficial for a further development of a broader music-technology landscape if the future ICMC tried to encourage a dialogue between the academic and non-academic world of computer music.

C.Hope: It is true that branches of computer music are popping up all over. We are also convening an inaugural animated notation conference soon. But I think that rather than being in competition, they compliment each other – it is just a result of the way computer music is moving and changing; or computing has become increasingly prevalent in all aspects of music practice. I think to keep ICMC relevant it needs to have an open minded curatorial platform about the kinds of music and research it seeks and takes on; keep its broad, worldwide focus; look beyond the university circuit without deserting it, become more affordable, support young practioners, women and students through different programs; and engage directly with the community that hosts it. Those conferences in 'the same space' could make good partners!

Book Review

Andy Farnell
Designing Sound
MIT Press, 2010 (664 pages, ISBN 978-0-262-01441-0)
Reviewed by Andrew Connor

Andy Farnell has written Designing Sound as "a textbook for anyone who wishes to understand and create sound effects from nothing". As an occasional sound designer for short films I have often found myself frustrated by an inability to produce either the exact sound I need, or, failing that, something I can modify to get close to my requirements¬. I have an abiding memory of trying to create a helicopter sound to match a visual effect, followed by my shamefaced acceptance that I would have to use a commercial recording as I just didn't have the time and skills necessary. So for my money, any textbook on how to create sound effects from scratch has got to be worth a look.

From the start, the book comes across as an approachable and readable basic text on the subject. Farnell introduces exactly what he aims to cover in the book, along with the principles and techniques he will explore. It is quickly established that the later chapters in the book will deal with the practical aspects of creating sound effects, and that the signal processing language Pure Data (Pd) will serve as the main software tool for achieving this.

The book consists of four parts, moving from an introduction to the theory underpinning his approach, through the tools and techniques he recommends for approaching the creation and manipulation of sound, to a substantial final section giving practical examples and illustrating how to use Pd for each sound effect.

The introductory chapters root sound design in three pillars of knowledge: the physical, mathematical and psychological properties of sound. These three pillars support technique, which in turn is the basis for design. He takes a few chapters to investigate the physical and mathematical properties of sound, starting from the basics of acoustics - a handy reminder of my physics school lessons. He covers the physical properties of sound; the creation and propagation of sound waves and the effects of boundaries; how oscillators work and the principles of simple and complex harmonies; and other basic principles. Each chapter is well structured and covers the topics succinctly, but with enough detail to convey the concepts. In addition, each chapter ends with a useful reference section pointing the interested reader towards further study of any of the topics raised. This makes the book even more useful as a classroom text, since each chapter can be used as a launch point to encourage students to explore their own interests further.

The psychological aspects of sound are covered in one much longer chapter, again touching on each topic quite briefly, but also giving enough of a taste to encourage the reader further. The basic mechanisms by which the ear and brain hears and interprets sound are covered, as well as how sound is identified and recognised. Bregman's ideas on auditory scene analysis are also summarised in a section that will be of particular interest to sound designers interested in crafting sonic landscapes to capture an audience's attention.

The final chapter in this section introduces the basic principles of converting the analogue sound we hear to the digital signals that can be recorded and processed using digital technology. The idea of sampling and its limitations are covered, as well as the basics of coding and how computer languages tend to look. Pd is introduced as a visual coding language for digital signal processing. Its main advantages are highlighted, chief amongst them being the notion that 'the diagram is the program' (each patch contains its complete state visually), and its economy of design when compared to other data flow languages. Another advantage of Pd is of course that it is open source and freely available for Windows, Mac, and Linux platforms.

The second part of the book concentrates on the tools available to the sound designer, in particular, the tools available within Pd. The chapters move from the basic starting steps in acquiring, installing and getting to grips with Pd through to the more specific elements that allow direct manipulation of sound. The terminology of canvases, patches, objects and connectors is covered, and the method in which repetitive or frequent functions can be abstracted into subroutines or sub-patches. Common practices and techniques are outlined, and the use of specifically useful objects available in Pd, which allow easy fading, panning, chorus and reverb effects.

As I have a passing familiarity with Pd's sister language, the commercial program Max, I initially leafed through this section quite quickly, as I imagined it would be very similar. However, my familiarity has faded over time, and there are enough small but vital differences between the two languages that I quickly realised I needed to pay more attention to these basics. As with the first part, Farnell has covered the basic concepts succinctly and has provided further references for more in depth detail. I occasionally found his explanations a bit

too brief, but playing around in Pd soon made the use of the objects clear. In the third section, Farnell moves on to technique. Making use of a software engineering approach as a parallel to the strategic production of sound design, he encourages a methodical approach to synthesising sound, allowing the designer to maintain their perspective and avoid getting too tied up in any one single approach to achieve their goal. He provides a basic introduction to five techniques for creating sound effects – summation, tables, nonlinear functions, modulation, and manipulating grains. His descriptions are again brief but informative, and frequently quite pithy –consider his description of granular synthesis as "painting in sound with a pointillistic style".

This section concludes with an examination of game audio, and the fundamentals of sound production for this market. The advantages and disadvantages of samples and procedural audio are examined, and the traditional audio engine model for games outlined. He also briefly touches on the new challenges and likely developments in game audio. As this is an area I have little experience in, I found this a good introduction to the topic. However, given the speed with which the games industry is developing, I suspect this to be the chapter will date quickest.

The final part of the book makes up at least half of the page count. This covers practical aspects of using Pd to create specific sound effects from scratch. For each one, Farnell investigates how to analyse and model the fundamental sounds involved. He then creates an implementation of the model using Pd, explaining the objects and dataflow in the patch and sub-patches shown. The patches and resulting sounds are also available on line, so the reader can compare their own patch to the 'correct' version. Farnell then provides further conclusions, limitations and practical considerations on how the Pd model matches up to the original sound, and if there are any deviations from the original specification. He also provides further challenges to the reader – having created the sound of a pedestrian crossing, we are invited to create the sound of a microwave, or to consider in further detail how the sound of crossing signals assist in road safety.

The practical sound effects section covers a range, from the sound of a pedestrian crossing through to the 'red alert' sound from Star Trek, and going by way of telephones, running water, jet engines, birds, explosions, and many others. I have only tried a few of these so far, and have not made it as far as the more complicated combinations of patches and sub-patches, but have found each exercise to be clear and easy to follow. In general, the book provides a clear and basic introduction to the principles behind designing sound effects. It does not set out to give an in depth description of everything, but covers the basics concisely and provides further references to allow the interested reader to explore concepts in further detail. The sections on tools and techniques establish how the sound designer can start to examine, analyse and model implementations of original sounds to synthesise their own versions, and by extension create entirely new sounds based on solid fundamental sound physics. The final section covering practical application of these basics, with specific examples in Pd, is ideal in both giving very useful, immediately accessible examples for the reader to try, but also encourages experimentation, modifications and the development of new Pd patches to create many other original sound effects.

I suspect I will be returning to this book frequently when I need to create that specific sound effect that I just can't record or fake in any other way. And the crowning glory is, of course, the patch that allows me to create my very own helicopter sound.

CD Review

Erdem Helvacioğlu and Şirin Pancaroğlu: Resonating Universes Sargasso (SCD28064)
Reviewed by Alistair Zaldua

Sargasso's latest publication is a set of eight pieces presented by composer Erdem Helvacioğlu and harpist Şirin Pancaroğlu. Helvacioğlu is a very successful young Turkish composer whose (now somewhat outdated) website reveals his having composed for film, theatre, dance, as well as for video and sound art, and that his work has been performed at many international festivals for computer and electronic music. The equally successful Şirin Pancaroğlu is described on her own website as "Turkey's most renowned harpist", and that for her "discovering a variety of musical identities for the harp is one of her constant endeavors." On the evidence of this disk, these interests are clearly borne out. From the information given it appears that Pancaroğlu not only performs on the harp, but also on the çeng (an ancient Turkish open harp), and the electric harp, whilst Helvacioğlu commands the electronics.

Most of the music presented is reliant on reverberant sound reminiscent, whether conscious or not, of middle-period Cocteau Twins, or even the instrumental and percussive textures of James Dillon's L'œuvre au Noir, and the ever-present drones even suggest Indian Classical music; the echo chambers here are as much cultural as they are stylistic. The CD consists of eight parts of unequal duration, each with their own distinctive character, but all serving to describe the ever-changing resonant universes referred to in the title. There are many things to observe here that a single listening would do little justice to. Lasting merely an hour, the impressions are of expansive, lavish, and sensitively sculpted sound landscapes. The sonic environment is often inventive and idyllic, and the gentle layering and combination of the sounds are at times playfully non-directional.

Throughout, Pancaroğlu displays a tour de force of listening and of the delicate choice and uses of playing techniques at her disposal. It is not always clear if the sounds are all derived from the harp itself; amongst the harp sounds can be heard what sound like distant distorted guitars as well as percussively metallic and wooden pulses, although the former could be Pancaroğlu's electric harp and the latter a percussive beater being stroked against the tuning pegs. In amongst the rather chaotic-sounding soundscapes appear sudden moments of clarity, which often come as a relief to the ear. Regarding Pancaroğlu's extended playing techniques, the resonant universes displayed here attest to a considerable amount of experiment and excavation in the possibilities offered by the harp, and in how both performers interact. The sounds Pancaroğlu produces go well beyond those found in Helmut Lachenmann's scores. The close micing of much of Pancaroğlu's sound intensifies the experience and it often feels like the listener's ear is adjacent to her harp. Acoustically, the notes at the lower end of the harp tend to take a short while to project, but the performers demonstrate that they are aware of this and the danger of creating dull and aimlessly muddy textures is keenly avoided; the reverberant techniques used create distance and add dimension to the whole.

The pieces range from three to eight minutes in length. The shortest piece, part 4, in its use of crashing metallic sounds serves to creatively break the main flow of the music until then. The work achieved in these shorter forms is to my ears more successful, especially the extended acoustic harp solo, the stopped harmonics in part 3, and the concrete sections of part 5. The pair do seem to have a little difficulty while working on the longer form. The seven pieces accumulate in energy to provide a well sculpted pedestal for the final work, running over 15 minutes. This final essay, part 8, provides a somewhat drawn out cadence to the whole, and seems a little labored. Despite my misgivings about this final track, here it is as if the origin of the enormous palette of sounds is finally revealed. There seems to be a scale running between the extended sounds of the distorted electric harp, through the plucked harp resonances towards the noisy, granular, and metallic tuning-peg sounds. The final aspect of the recording to address is the role played by the electronics. These tend to occupy several different functions at once, providing a drone-filled backdrop; a constantly shifting reverberant cloud of sound; at times deliberately understated sympathetic resonances; and then suddenly taking centre stage as the main 'instrument'. A source of the seduction of this CD is that the roles both harp and electronics have are never static.

In view of these achievements, Sargasso chose to print their own label name on the front of the CD, inviting us to 'take a plunge in the Sea of Sound', but without mentioning the musicians themselves. It's only on the back and sides of the CD where both the title of the disc and the names of musicians are revealed. Neither do the sleeve notes disclose anything: all that is presented is the total catalogue of other CDs one could order from Sargasso. On the plus side, this choice of minimal information might be sending the healthy

message of ‘think for yourself’ rather than allowing the overload of biographical and extra-musical information commonly seen on many recordings, which can detrimentally influence a listeners opinion. Despite this I feel it does these musicians a disservice as the music offered on this CD is both as rich in content and craftsmanship as the listening experience to be gained from it. For example, I was curious to learn about how these musicians may have worked together. The music on the disc sounds more improvised than composed; how much of this was the result of some outstanding collaborative work? The musicians were obviously concerned to let the electronics reveal the deeply sensuous nature of the different harps played. But whether the result of a collaboration or of a worked through composition, both Helvacioğlu and Pancaroğlu have produced a recording that contains many hidden subtleties to discover and admire. For the discerning listener not put off by the ever present reverb, but curious to hear an introductory portrait of two outstanding Turkish musicians, this compact suite of eight pieces is highly recommended.