
EDITORIAL

Interconnection has always been a fundamental principle of music, prompting experimental artists to explore the implications of linking their computers together long before the Internet reached the public consciousness. As with any new technology, applications of networking to music have evolved from naïve proofs-of-concept to more sophisticated projects, and we stand now at a point where internetworking is taken for granted, novelty is expiring, and artistic goals more often transcend technical considerations.

This issue marks the fourth in an annual series of collaborations between *Organised Sound* and the International Computer Music Association (ICMA), with previous themes including 'Performing with Technology' and 'Collaboration and Intermedia'. In exploring these prior areas, networking has emerged as a common element underlying a wide variety of innovative projects, prompting a more focused look at the mutual influence between networks and music. This should be no surprise in the field of electroacoustic music, where our machines are partners as much as tools, and working with other artists or often even solo requires connection among multiple devices. In the pre-network era, technical obstacles frequently dictated that much computer music occurred in relative isolation, with musicians expending precious attention acting as interpreters between hardware and other humans. So in one sense, networked music can be simply a recapitulation of acoustic music principles, of listening and sensitivity to other performers and audience, by enabling computers to participate equally in the musical conversation. Networking can also radically alter these traditional principles, most obviously by decoupling the spatial framework, enabling some or all of the participants to act and perceive without being physically present. Thus networked music is fertile territory for the composers, performers and researchers that comprise the ICMA as both a potential means of overcoming challenging limitations of technology, as well as presenting new possibilities we have yet to imagine.

As the Internet achieved critical mass over the past decade, networking technology took centre stage as the key to a vast new territory of possibility, facilitating remote participation, distributed processing, and redefinition of musical space and time. The Web emerged as a virtual venue for countless musical

purposes, and as analogue acoustics transformed to digital representations, packets of data carried by IP from one address to another became a modern metaphor for air molecules transmitting the tone of vibrating body to eardrum.

In 'Electronic, aesthetic and social factors in Net music', Golo Föllmer conducts a broad survey of the field, analysing a wide range of musical projects that approach internetworking from many distinct perspectives. Based upon assessment of some seventy examples considered to be classifiable as net music, Föllmer posits a basic taxonomy categorising the scope of existing techniques applied to harnessing electronic networks for making music. Föllmer maps these works spatially onto a three-dimensional surface by comparing factors of interactivity/openness, interplay with network characteristics, and complexity/flexibility.

As reflected in this diversity of current projects, networked music is now a well-established paradigm – performances are commonplace and their supporting hardware and software infrastructure is well established. Two systems, Open Sound Control (OSC) and Soundmesh, have been in use for over five years and are well documented technically in the literature. Here Matthew Wright explores OSC from a somewhat different angle in 'Open Sound Control: an enabling technology for musical networking'. Wright first describes the protocol, followed by a discussion on the theoretical limits of communication latency and subsequent implications for remote interactivity. He includes a representative list of many projects that take advantage of OSC, evaluating each project in terms of the paradigm of musical interaction that it provides. Mara Helmuth looks at several projects using networking over high-bandwidth links in 'Virtual musical performance and improvisation on Internet2'. She has used Internet2 to distribute a performance over the network in real time, collaborate virtually in programming composition and performance, and to facilitate remote improvisation with Soundmesh. Helmuth's experience in this area is apparent as she elaborates not only on the technical considerations in taking maximum advantage of cutting-edge infrastructure, but also explains the impact of the technology on aesthetic decisions, and how those have translated with greater and lesser success to the experience of participants and audience.

As the evolution of networked music continues, the essential question transforms to not how networking and music are combined, but why. What is the unique experience that can be created? Whose role can be empowered or transformed – composer, performer, audience? Where can sound come alive that it couldn't otherwise? Networked music can reinterpret traditional perspectives on stagecraft, ensemble, improvisation, instrumentation and collaboration, or enable otherwise impractical relationships between controllers, sensors, processors, inputs and outputs. In 'Interactive Network Performance: a dream worth dreaming?' Ajay Kapur, Ge Wang, Philip Davidson and Perry R. Cook pose a fundamental question: Is the concept of musicians in multiple locations around the world performing together in real time using high speed Internet, with no latency, in front of live audiences worthwhile? This paper describes each component of *The Gigapop Ritual*, a network-based performance between McGill and Princeton Universities. This live collaborative musical event, weaving cyber-electronics and Indian classical tradition, involved high-bandwidth, bi-directional, real-time streaming of audio, video, and controller data from multiple sources to and from expert performers at both sites.

Jason Freeman, Kristjan Varnik, Sekhar Ramakrishnan, Max Neuhaus, Phil Burk and David Birchfield developed a project to give the lay public with limited musical training or technical expertise a networked musical experience – a 'sound dialogue'. In 'Auracle: a voice-controlled, networked sound instrument', the authors describe a network application which enables users to control a software synthesizer with their voice and to interact with each other in real time over the Internet. The paper discusses the historical background of the project, beginning with Neuhaus' 'virtual aural spaces' of the 1960s and relating them to Barbosa's conception of 'shared sonic environments'. The architecture of the system is described in detail, including the multi-level analysis of vocal input, communication of this analysis data across the network, mapping the transformed input onto a software synthesizer, and the collaborative networked processes of the project's development mechanisms.

Álvaro Barbosa examines one of his recent virtual sonic spaces in '*Public Sound Objects*: a shared environment for networked music practice on the Web'. The *Public Sound Objects* (PSOs) project consists of the development of a networked musical system as an experimental framework to implement and test new concepts for online music communication. Barbosa goes beyond the paradigm of distributed performance in which the network is mainly used as a channel to provide a connection between performative spaces. Instead he explores the shared nature of the Internet in

order to provide a virtual public musical venue where anonymous users can meet and be found performing in collective sonic art pieces. The system itself is an interface-decoupled musical instrument, in which a remote user interface and a sound processing engine reside with different hosts such that users can access the synthesizer and participate fully via any machine with a standard connection to the World Wide Web.

One of the issues facing networked music is painfully familiar – the question of expertise. As new projects reinvent their own idiosyncratic implementations of mapping gestures to audio, users often encounter frustrating difficulty in creating sounds and structures that reflect their musical intent, whether they are novices without formal training or experienced composers or performers of other instruments. Evandro Manara Miletto, Marcelo Soares Pimenta, Rosa Maria Vicari and Luciano Vargas Flores attempt to address this challenge in 'CODES: a web-based environment for cooperative music prototyping' by devising an environment in which practice and collaborative improvement are intrinsic to the system. By considering the process of generating and refining 'prototypes' as a valuable musical journey and only incidentally as a means to a fixed artefact, CODES aims to emphasise learning and cooperation, where the space may be virtual but the community is real.

Gil Weinberg also addresses the question of rapidly enabling novice sound-makers to generate satisfying musical experiences in 'Local Performance Networks: musical interdependency through gestures and controllers'. Weinberg presents the evolution of this idea at the MIT Media Lab through four project stages: 'Squeezables', 'Musical Fireflies', 'Beatbugs', and 'Voice Patterns'. Each of these stages represents a discrete improvement over the previous implementation, based on user feedback regarding the strengths and limitations of each generation of instruments. This journey of invention serves as a valuable model for others as a means of converging towards a vision of artistic potential through successive cycles of optimisation. Unlike the papers mentioned so far, the network communication among participants was localised to the same venue, supplementing feedback from the interface 'creatures' with a simultaneous shared experience of sound and physical movement. An appropriate analogy might be to a chamber music ensemble in which the players had only encountered their instruments a few hours prior to performance, but with their skills augmented by the fact that their instruments can communicate amongst themselves in both straightforward and complex ways. Weinberg demonstrates persuasively that such multidimensional communication can lead to potentially sophisticated musical outcomes, reflecting in equal parts performer intent and unexpectedly rich emergent behaviour.

Finally, in 'Network Dynamics in *Sustainable*: a robotic sound installation', David Birchfield, David

Lorig and Kelly Phillips also present an unusual reconception of networked music, interconnecting seven water gongs as nodes communicating directly through literal analogue pipes, transmitting data as an ever-fluctuating flow of liquid. 'Sustainable' conflates the network concept into a single instrument, re-imagining the chamber ensemble as a fully interdependent creature, in which change at any single node mandates a coordinated response from all other nodes, resulting in an organic shaping of dynamic sonic relationships. In addition to functioning as a musical and visual work, *Sustainable* also operates on a metaphorical level, representing the compromises inherent in real-world resource management. By encouraging us to grapple with networking not only as a technology, but also as a philosophy of human relationships and the inherent inequalities therein, *Sustainable* makes a crucial link between art and life, reminding us that interconnectedness is the basis for the ecology in which we all share responsibility for our collective harmony or discord.

This collection of articles is intended as a snapshot of the state of networked music, and hopefully provides some inspiration towards additional development and new directions of pursuit. Despite the existence of many persistent spheres for the creation of networked music, none seem to have yet found the combination of usability and compelling results to ignite widespread awareness and participation. There are still many questions about how best to incorporate the intrinsic characteristics of networked communication into musical form. The network can be an interface, a medium, an amplifier, a microphone, a mirror, a conduit, a cloud or a heartbeat. Competition among the diverse perspectives and realisations of networked music concepts remains fierce. Which ideas will thrive and which will wither is unknowable. No dominant

technique or prevailing aesthetic has yet emerged in the struggle to most faithfully represent what is unique about the networked music paradigm. What we have is an ecology still undergoing rapid change, subject to dramatic mutation, recombination, and selective pressures, one of the most exciting and dynamic periods in the maturity of any field. What may be the next step in this process is the recognition of networked music as a true ecosystem, in which each of the projects with a connection to the Internet publishes some meaningful aspect(s) of its identity for access and manipulation by others. For example, a virtual collaborative space that produces a shared sonic outcome could not only publish its music to the participants, but also make the resultant data available in some standard interchange format such that other projects could use that real-time flow of information as an input source. Why not take the tapestry of networked music to this next level, interconnecting not only people and machines, but entire environments? Ideally, the technology will begin to become transparent, invisible as the air we breathe, even as the nature of the medium begins to define its own sonic parameters, giving birth to a new musicality grounded inextricably in the technology. When the sound, interaction, and human experience of a work are inconceivable detached from the network, then we can start to imagine masterpieces in this genre.

The network is all of us. Music is the sound we make. Listen . . .

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