SARC: STUDIO REPORT

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ABSTRACT

The Sonic Arts Research Centre at Queen’s University Belfast was established in February 2001. This paper outlines the major developments at the Centre since its purpose built facilities were formally opened in April 2004; it describes the flagship resource of the Centre – the world’s first Sonic Laboratory; it discusses some of the research projects currently in progress and recent compositional activity at SARC; and it summarises future developments planned for the Centre.

1. INTRODUCTION

The Sonic Arts Research Centre was established at Queen’s University Belfast, Northern Ireland in February 2001. The Centre, the first purpose-built facility of its kind in the UK, has brought together over fifty researchers working in the fields of music, computer science and electrical and electronic engineering into a world-class research group. Construction of the new purpose-built facilities began in July 2002 and was completed in October 2003.

The new building houses five multi-channel studios, two computer labs, meeting rooms, seminar spaces and the world’s first Sonic Laboratory. It was formally opened by Karlheinz Stockhausen in April 2004 as part of the Sonorities Festival of Contemporary Music 2004 (http://www.qub.ac.uk/sonorities). Since its opening, the Centre has won an award for construction excellence from the Construction Employment Federation (CEF) and a commendation at the 2004 BIAT (British Institute of Architectural Technologists) awards for technical excellence.

2. THE SONIC LABORATORY

The Sonic Laboratory is a unique multi-functional concert hall / research laboratory. It can accommodate an audience of up to 150 and features a 48-channel sound diffusion system.

2.1. The Structure

The lab measures 17m L x 13m W x 14m H. Audiences and researchers enter the lab at ground floor level and walk out onto an acoustically transparent, modular grid floor suspended 4m above the structural floor of the lab located at lower ground floor level. Approximately 7m above the audience area is a technical gantry spanning the perimeter of the lab and nine motorised ceiling panels which can be independently lowered to ground floor level. The ceiling panels are rectangular aluminium box trusses (2m x 1m) from which loudspeakers, stage lights and/or microphones can be suspended.

The lab can be configured for a wide range of acoustic responses e.g. at 1kHz the reverberation time of the space can be made to vary from 0.4 – 2.3 seconds. This is achieved through a series of 48 acoustic absorbers which can be raised or lowered to expose or cover each of the walls. There are two mechanical pulley systems per wall and each pulley controls 6 absorbers. Additionally there are over 300 portable absorbers available for distribution across the structural...
2.2. Sound Diffusion

During construction of the Sonic Laboratory, 112 loudspeaker tielines were installed at strategic points in the space - 40 at ground floor level, 20 at lower ground floor level, 16 at gantry level and 4 per ceiling panel. This provides considerable flexibility in the positioning of loudspeakers for a variety of sound diffusion scenarios. The ‘house’ configuration is arranged as 5 layers of 8 channels plus 6 discrete subwoofer channels. Layer 1 at ground floor level consists of 4 x Genelec 1038Bs and 4 x Genelec 1037Bs in an octophonic configuration plus 2 Genelec 7071A subwoofers located front centre and rear centre. Layer 2 consists of 8 x Meyer UPJ-1Ps also in an octophonic configuration suspended from the technical gantry approximately 5m above the ground floor. There are also 2 Meyer UMS-1P subwoofers at this level suspended front centre and rear centre. Layer 3 consists of 8 x Meyer UPM-1Ps which hang from the four corner ceiling panels. Layer 4 is a second cluster of 8 x Meyer UPM-1Ps suspended approximately 1m below the grid floor. Finally layer 5 is another layer of 8 x Meyer UPJ-1Ps at lower ground floor level (4m below the grid floor) with 2 Meyer UMS-1P subwoofers front centre and rear centre.

The sound diffusion system is built around a Digidesign Control-24 mixing surface located in the centre of the Lab at ground floor level which controls a ProTools HD3 Accel system. Three Digidesign 192 I/O audio interfaces provide 24 analogue inputs and 48 analogue outputs. The host Apple PowerMac G5 and audio interfaces are housed in a Sound Construction 24U Isobox Post located at lower ground floor level. A 24-way multicore links the central mixing position and interface inputs at the Isobox and the 48 interface outputs are available on a patchbay allowing flexible routing to any of the 112 loudspeaker tielines.

2.3. Lighting

The stage lighting system for the Lab consists of an ETC Express 125/250 console controlling 24 x ETC Source 4 PAR 750W and 22 x Aurora CYC 1250W Floods. A total of 102 dimmers are available in the Lab - 6 per ceiling panel, 16 at ground floor level, 16 at technical gantry level and 12 at lower ground floor level.

3. RESEARCH PROJECTS

The research activities at SARC are many and varied and include work areas such as blind de-reverberation of audio signals, intelligent monophonic and polyphonic score following, musical prosthesis, music data mining, audio for next-generation computer gaming, audio for wireless PDAs, computational music analysis and composition, physics-based analysis and synthesis of sound, multi modal databases, hardware solutions for musical instrument synthesis, hardware solutions for room acoustic simulation, intelligent tutoring systems.

Detailed below are four or the recently funded projects currently underway at SARC.

3.1. Audio Alchemy

In December 2003, SARC announced a £1m collaborative research project with DTS (Digital Theater Systems) which will focus on the development of new multi-channel audio technologies. The project is looking at a number of areas including research into:

- blind deconvolution source separation algorithms
- independent component analysis algorithms
- virtual room modelling and microphone simulation
- systems demonstrator development

To date a number of promising algorithms have been demonstrated for independent component analysis.

3.2. ENABLED

ENABLED (Enhanced Network Accessibility for the Blind and Visually Impaired) is a 3 year, £2.5m EU funded project involving SARC and VEC (the Virtual Engineering Centre) at Queen’s University Belfast and a further twelve European partners. The project, which began in September 2004, aims to provide greater accessibility to the Internet for visually impaired users or users with some other form of disability.

The aims of the project are to:

- develop technologies that create universally accessible contents on the Web
- develop algorithms that convert existing inaccessible contents into a more accessible format for visually impaired users
- develop (ubiquitous) tools that enable easy access to information
- develop interfaces that are adaptable and interoperable no matter where the user is and what equipment the user is using

Research and development is being focused on four specific areas:

- accessible Web content
- adaptable interfaces
- mobile computing
- wireless networking

3.3. Multi Modal Internet Access

The Multi-Modal Internet Access project is a 3 year, £140k Eduserv funded project which commenced in May 2004. The aims of this project are to develop
techniques of interacting with the Internet which will be of benefit to the visually impaired - in particular, the use of haptic and audio information to provide non-visual methods for interacting with the Internet. The project is primarily concerned with navigational issues (hyperlinks, next page etc.) which to date have been very visually oriented. As such, it is envisaged that the results of this project will be of benefit beyond the Internet domain to allow visually impaired users access to other forms of computer-based data, e.g. databases and Internet banking.

3.4. Novel Numerical Approaches for Physical Modelling Synthesis

This project centers around the exploration of new numerical techniques (adapted from other areas of simulation research) to musical sound synthesis. A particular focus is on nonlinear distributed systems, and the adaptation of energy-conserving and spectral methods, in order to arrive at high-quality synthetic sound. The project is of three years duration; computing resources and travel funds are available.

4. INSTALLATIONS

4.1. Interactive Audio Environment

In response to a request for a novel sound installation from the Royal Victoria Hospitals, SARC staff and students have devised an interactive audio environment for the main corridor space in the new hospital building which responds dynamically to the movement of people in the area. A pilot project was implemented from August – September 2002. Following the pilot, the Hospital’s Arts and Heritage unit made a successful application to the Arts Council of Northern Ireland’s National Lottery Fund to create a permanent installation. Composers Michael Alcorn, Pedro Rebelo, Paul Wilson have recently completed an expanded, multi-channel installation which will be installed in the main hospital from April 2005 onwards.

The system is based around two Apple PowerMac G5 workstations – one for video analysis and the second for sound diffusion. The video analysis workstation uses MAX/MSP/Jitter to process the input from four webcams mounted at high level along the corridor. The webcams and software are configured to provide information on the areas of maximum movement in the four video frames. This data is then freely exploited in any of the short installation works which run throughout the day.

One of the most unusual features of the system is the control environment for the MAX/MSP patches. AppleScript is used to control the opening and closing of patches according to random of predefined durations for each patch. The environment is extensible with the ability to simply drag and drop new patches into the performance folder. Such additions are automatically added to the list of available patches for a given time of the day.

The sound diffusion system consists of 16 Genelec 1029A loudspeakers fed from a MOTU 24I/O audio interface under the control of the sound diffusion workstation.

4.2. Sonic Constructs

Sonic Constructs is an installation using Lego Mindstorm robotics kits as semi-automata musical robots. Lego Mindstorm is a kit for the creation of simple robotic devices. It represents an extension of Lego’s brick metaphor onto a world of sensors, actuators and programmable behaviours. Visitors participate in the work by constructing their own Lego structures which in turn become actual sound making objects. As a fragile construction navigates through space it is interrupted by unavoidable collision, by the threshold that defines that same space. The collision causes the construction to collapse, creating an environment of fragments, debris. This environment becomes the space for kinetic and acoustic participation. A resonant metal plate acts as a surface on which the constructs operate. This works as a sound stage as well as a platform for interaction. Mechanical action is carried through by robotic devices and it is the by-product of such action that provides sonic material. As Lego pieces collide, move and scratch, a complex sonic world is orchestrated. These, sometimes microscopic sonic events become prominent and are further manipulated with real-time electronic processes. Sonic Constructs was exhibited at the New Forms Festival in Vancouver (14-28 October 2004).

4.3. Oxidising the Spectrum

‘Oxidising the spectrum’ is a sonic installation by Ricardo Climent and Quan Gan which explores the
possibilities of microbial electrochemistry in the compositional environment. The installation was sponsored by the Arts Council of Northern Ireland and presented in the Tropical Ravine, Botanic Gardens, Belfast as part of the Sonorities Festival of Contemporary Music 2004.

The installation is based around four microbial fuel cells (MFCs) and a Javelin Stamp PIC. As the microorganisms oxidise the fuel (a carbohydrate), they start a process of voltage charge and discharge which repeats as long as they are constantly fed. This charge / discharge cycle of 18-20 minutes was the starting point for the installation. The electricity generated is converted into MIDI and audio data and the MIDI information used to control a number of musical parameters. The use of four fuel cells provides the potential to derive patterns and musical ideas from the cycles. One of the main aims from a compositional perspective was to find ways of destabilising the optimal conditions of the living cell in order to induce musically expressive variations of the cycles. In addition to the data generated by the fuel cells, the installation used a variety of additional sensors to generate further control data including photo-resistors, a sonar mounted on a servo, barometers, thermostats, rain detectors, mini-solar panels, and webcams to map variations in colour of the MCF during the process of oxidation.

5. CONCERTS & COMPOSITION ACTIVITIES

SARC contributes concert events throughout the year and during two major Festivals in Belfast during the year. In November 2004 the Centre presented four concerts during the Belfast Festival at Queen’s, the second largest Arts Festival in the United Kingdom. The concerts included a performance by the Maltese percussionist Renzo Spiteri of pieces by composers working at SARC. In April 2005 we presented the 22\textsuperscript{nd} annual Sonorities Festival of Contemporary Music. The 2005 Festival presented a profile of international artists who deliberately engage in modes of creativity which go beyond the definitions of music, visual or performance arts. Participating artists included Luc Ferrari, Ed Osborn, Miso Ensemble, Nic Collins, Frances Lynch, John Kenny and Chris Wheeler, John Young, João Pedro Oliveira, Albert Ortega, Martin Franklin, Rajmil Fischman, David Berezan, Andrew Czink, Michael Clarke, I a u t, Christian Eloy, the Ulster Orchestra, Renzo Spiteri, Hannes Raffsader, Martin Parker, Eduardo Miranda, Scott Krejci, Eric Lyon, Annette Vande Gorn, Uli Mitzlavl, Miguel Pereira, Michael Alcorn, Ed Bennet, Ricardo Climent, Paulo Raposo, Ludger Brummer, Adrian Moore, Maki Namekawa, Sebastian Castagna, Ian Stewart, Gordon Delap, The Murmurists, Ensemble Proxima Centauri. The Festival included a full day of events in venues around the city's cultural district including a performance at St. George's Market, a boat tour, Music by Frank Zappa, performed by Ulster Orchestra under the direction of Philippe Nahon and a club night.

Works created by SARC composers:


Ricardo Climent: ‘The Last Castrati’ for 2-channel Tape; ‘Sonic Tsunami’ for 2-channel Tape; ‘Sons étouffés’ for symphony orchestra; ‘3_Simetrias / Irregularidades II’ for symphony orchestra; ‘Biometric Fingerprints’ for brass quintet; ‘914 MHz’ for baritone saxophone and dancer; ‘A Gravidade Liberta’ for marimba, prepared mallets and live electronics.

Gordon Delap: ‘Light Body Corpuscles’ for video and 5-channel tape; ‘Beowulf and Grendal’ for live reading and live electronics; ‘Pathless Desert’ for 2-channel tape.

Jason Geistweidt: ‘A letter from the trenches of Adrianopolis . . .' for 2-channel tape which was awarded the emsPrize for electroacoustic music by Electronic Music Sweden (EMS).


Christopher McClelland: ‘Forage’ for 2-channel tape; ‘Freaks of Kleptomania’ for piano and live electronics.