

Sonic Arts Research Centre (SARC)

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Abstract

The Sonic Arts Research Centre at Queen's University Belfast was established in 2001 and its purpose-built accommodation opened in September 2003. This paper describes the resources at SARC; it discusses the primary research activities of the Centre; it outlines the taught postgraduate and undergraduate programmes offered at SARC; and it summarises future developments at the Centre.

1 Introduction

The Sonic Arts Research Centre was established at Queen's University Belfast, Northern Ireland in 2001. The Centre, the first purpose-built facility of its kind in the UK, has brought together key researchers working in the fields of music, computer science and electrical and electronic engineering into a world-class research group. The team, which has grown to over thirty people, is now one of the biggest groups of its kind in Europe and has been actively recruiting staff from industry and from leading institutions such as Stanford University.

2 Resources

Central to the establishment of this initiative was the creation of a new, specially designed building which brings the staff together in a unique working environment. The building, which opened in September 2003, houses computer labs, multi-channel studios, meeting rooms, seminar spaces, offices and the world's first Sonic Laboratory.



Figure 1: Visualisation of SARC

2.1 The Sonic Laboratory

The Sonic Laboratory is a unique multi-functional concert hall, research laboratory and recording studio. One of the most distinctive features of the Lab is its acoustically transparent, suspended floor which spans the entire floor area. Audiences and researchers located on the floor experience true three-dimensional sound projection from more than seventy active loudspeakers and subwoofers (Genelec, Meyer etc.) mounted both above and below the audience area. Over 120 loudspeaker tielines are installed in the Lab to allow a high degree of flexibility in the configuration and positioning of loudspeaker arrays. The space also features variable acoustic wall panels and variable ceiling panels. The latter structures can be lowered as independently controllable sections from 11m high right down the floor level. The Lab has already proven to be an attractive resource to industry, researchers, composers and musicians from around the world.



Figure 2: Visualisation of the Sonic Laboratory

2.2 Studios

SARC is home to five of the eleven sound studio spaces at Queen's. All of the SARC studios have been acoustically isolated and treated in consultation with ARUP acoustics.

Control Room: Directly adjacent to the Sonic Laboratory is a control room allowing the Lab to be used as a recording studio. The two rooms are linked by 48 microphone lines and a vision panel. The control room features 5.1 Genelec 1037C monitoring,

an expanded Digidesign ProTools HD3 system, a 32-channel ProControl system with Edit Pack, PrismSound ADA-8 converters, Focusrite ISA 428 and 430 microphone preamplifiers, Lexicon 960L and TC Electronic System 6000 outboard effects units, and microphones by Neumann, DPA, Schoeps and Soundfield. The studio also includes an ISDN link for outside broadcast. At the rear of the control room is an acoustically isolated machine room which also houses computer workstations from the other studio spaces.

Spatialisation Studio: A multi-channel studio for composing and mixing in 5.1, 7.1, octophonic and future surround sound formats. It features 10 channels of Genelec 1032A monitoring, a Digidesign ProTools HD3 system with a wide range of TDM plug-ins, a Macintosh G5 workstation running MAX/MSP/Jitter, multi-track tape recorders and a Yamaha DM1000 digital mixer. The room has also been designed in accordance with ITU recommendations (ITU-R BS 1116) to double as a critical listening room.

Mastering Studio: A single occupancy workstation room for composition and mastering work. It features 5.1 Genelec 1030A monitoring, a Digidesign ProTools HD1 system with Sonic Solutions noise reduction, a Mac G5 workstation running MAX/MSP/Jitter and a TC Electronic System 6000 with MD5.1.

Audio to Picture Studio: A single occupancy workstation room for composition, audio to picture mixing and video editing. It features 5.1 Genelec 1030A monitoring, a Digidesign ProTools HD1 system with AVoption, a Mac G5 workstation running MAX/MSP/Jitter, and an extensive collection of soundscapes and sound effects.

Interactive Composition Studio: A single occupancy workstation room with stereo Dynaudio BM15A monitoring for live electronics composition. It features a Digidesign ProTools HD1 system, a Mac G5 workstation running MAX/MSP/Jitter, and a wide range of commercial and in-house performance sensors. The studio can be rapidly relocated for performances in the Sonic Laboratory and is often used in conjunction with the Yamaha DC7A Pro Disklavier piano located in the Lab.

Harty Studio: The Harty Studio is located in the School of Music at Queen's and features a Yamaha digital mixer with a ProTools Mix system. 40 microphone tielines connect the control room to three independent recording areas: the Harty Room concert hall, the McMordie Hall and an isolated recording booth adjoining the control room. The studio also includes a video link to the Harty Room and an ISDN link for outside broadcast. The Harty Room and Harty Studio are regularly used by the BBC for live concert broadcasts.

Harrison Studio: The School of Music's multi-channel channel composition studio. This features 8 channel Genelec 1031A monitoring, a Yamaha DM1000 digital mixer and a ProTools Mix+ system hosting a wide range of TDM plug-ins.

Live Electronics Studios 1 and 2: A pair of identically equipped studios located in the School of Music. They are intended for realising live electronics performances. The studios are based around a Macintosh G4 workstation, a range of I-Cube and Doepfer controllers, and Max/MSP.

MIDI Workstation Studios 1 and 2: A second pair of identically equipped studios located in the School of Music. These provide a range of MIDI and audio devices including synthesisers, samplers and effects processors, attached to Macintosh G4 workstations for sequencing and sound design work.

2.3 Computer Labs

There are two computer labs at SARC and two computer labs at School of Music. The SARC labs comprise one sixteen seat lab for research students, and one twenty seat lab for postgraduate MSc students. The School of Music labs comprise two twelve seat labs for undergraduate student work. The workstations are a mixture of G4 iMacs running OSX and dual boot PCs running Windows and Red Hat Linux with a wide range of sound synthesis, audio editing, multimedia authoring, and music notation software. All of SARC's computer labs and studio workstations are networked to an Apple X-Serve server with a 2.52Tb fitted X-Serve RAID.

A central tieline room houses over eighty line level tielines interlinking each of the studio spaces and computer labs at SARC.

3 Research

There are currently three main research groups at SARC: Innovative Audio Systems Group, Music Informatics Group, and Composition and Sound Design Group. Fundamental to the research philosophy at SARC is the synergy between the three disciplines of music, computer science and electrical and electronic engineering. Each of the groups is interdisciplinary and they regularly collaborate with visiting researchers. The current research projects have resulted in the establishment of a number of external links within the creative and high technology industries. These include links with DTS, HP and Metrowerks.

3.1 Innovation Audio Systems

The overarching theme of the Innovative Audio Systems Group at SARC is "acoustics for listening spaces". The group is concerned with the design of tools which can be used both in consumer audio systems and for assisting musical creation. Research

interests of the group include: acoustic equalisation of rooms for multi-channel audio reproduction, perceptual auralisation, room geometry estimation, recording and reproduction techniques for multi-channel audio, external hardware interfaces for musical creativity, audio coding, fractals and chaos as applied to room acoustics.

Current work in progress includes an intelligent loudspeaker equalization system for assessing the acoustic properties of a given monitoring environment using spatio-temporal adaptation procedures, an automated multi-channel sound diffusion system based on real-time FFT and wavelet transform analysis of input audio streams, and spatialisation algorithms using HRTF convolution.

3.2 Music Informatics

The Music Informatics Group involves researchers from diverse disciplines such as music, computer science, cognitive science, psychology, engineering and bioinformatics, as well as various national and international collaborations. Research interests include: Artificial Intelligence techniques and applications to music analysis and composition, machine learning, pattern discovery and evaluation, score following and expressive performance, cognitive modelling, assessment of text critical information in manuscript sources, audio gaming technology, interfaces for special needs.

Work in progress includes the development of tools for music analysis and constraint based computer assisted composition, score following for intelligent piano tutoring systems, pattern discovery in Bach databases, and cognitive modelling in analytical tasks.

3.3 Composition and Sound Design

The work of the Composition and Sound Design Group underpins much of SARC's collective research output. The group collaborates closely with the IAS and MI groups to ensure that all aspects of research activity at SARC provide opportunities for creative 'output' in the form of composition e.g. electroacoustic works exploiting SARC's sound diffusion hardware and intelligent sound diffusion system, live electronics works for SARC designed musical controllers etc.

In March 2003, SARC released the first in a series of CDs featuring works realised at the Centre. Recent compositions include:

Michael Alcorn: "Synapse" (2003) for symphony orchestra and live electronics. Commissioned by RTE. Premiere - National Concert Hall, Dublin, 10th January 2003; "Natures" (2002) for live electronics. Commissioned by Musicon, University of Durham. Premiere - Elvet Methodist Church, 2nd May 2002.

Torstan Anders: "Aangesloten" (2003) for 8 channel tape. Commissioned by Thüringer

Komponistenverband [composers society of Thüringen].

Ludger Brümmer: "Xronos" (2002) for 3 videos and 4 channel tape. Commissioned by the French Ministry of Culture and Communication and the Siemens Foundation; "Schatten" (2002) for piano and 4 channel tape.

Ricardo Climent: "Reinventando a Bell" (2003) for percussion trio and custom built Electronic Expression Sensors. Commissioned by Instituto Valenciano de la Musica. Premiere - Palau de la Musica, Valencia, 23rd January 2003.

Gordon Delap: "Moai" (2003) for tape. Premiere - University of Oregon, 8th March 2003; "Learning your lines" (2002). Commissioned by the BBC for "Between the Ears"; "Toilet Graffiti" (2002) for jazz ensemble and live electronics.

Jason Geistweidt: "Trans-mission" (2003) for 4 channel tape.

Rachel Holstead: "One...many" (2003) for Balinese Gamelan, choir, percussion, soloists and live electronics. Commissioned by Tina Ramnarine. Premiere - Whitla Hall, Queen's University Belfast, 1st April 2003; "Jatayu" (2002) for flute, piccolo, alto flute and 8-channel tape. Commissioned by Jonathan McIntosh. Premiere - Sonorities Festival of Contemporary Music, School of Music, Queen's University Belfast, April 26th 2002.

Iain McCurdy: "Fluctuant Movement" (2003) for tape. Premiere - University of Oregon, 8th March 2003; "Learning your lines" (2002). Commissioned by the BBC for "Between the Ears".

4 Programmes

SARC offers a number of taught and research programmes catering for both postgraduate and undergraduate study.

4.1 Research Programmes

MPhil and PhD research degrees are offered at SARC completed over two and three years respectively. Supervision is available in areas such as audio DSP, room modelling, sensors, music and audio; HCI and music; PDA music applications; music informatics; sound design and composition; physical modelling of sounds and noise.

Since the centre was established in 2001, SARC has awarded eight fully funded PhD studentships. It is intended that a second phase of studentships will be announced in the near future.

4.2 MSc in Sonic Arts

September 2004 sees the launch of a new MSc in Sonic Arts based at SARC. This course replaces the existing MA in Music Technology (the first of its

kind in Ireland) which has been running for the past 12 years. The structure of the new MSc has been completely re-designed to reflect the research philosophy at SARC and as such is aimed at music, computer science and electrical and electronic engineering graduates. The course content draws heavily on the research activities and expertise of the staff at SARC and includes modules in sonic art composition, audio software engineering, digital signal processing, sound design for picture, digital audio technologies, recording techniques, physical modelling, music informatics, musical interfaces for creative expression.

4.3 BSc in Music Technology

Queen's also offers a BSc in Music Technology run by the School of Music with significant staff and resource input from SARC. The BSc course focuses on three main areas of study: creative and performance activities using studio technology; computer programming for musical applications; and sound engineering. Interested parties should contact the School of Music, Queen's University Belfast for further details <http://www.qub.ac.uk/music>.

5 Future Developments

May 2004 will see the official launch of the new SARC building. The occasion will be marked by a special programme of the annual Sonorities Festival of Contemporary Music at Queen's. This twelve day event will present work by leading composers and researchers from around the world.

SARC also expects to announce significant links with industry in the near future.