Center for New Music & Audio Technologies (CNMAT): Studio Report

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Abstract

The Center for New Music and Audio Technologies (CNMAT) began operating in 1989. It is a multi-disciplinary research center within the Department of Music at the University of California, Berkeley. New equipment, infrastructure, staff, software, music projects, and live recordings have all added significantly to the Center's expanding range of activities.

1 Introduction

CNMAT's mission is to explore the creative interaction between music, science, and technology. With an orientation towards live performance and research, the Center provides facilities, expertise, and educational opportunities to individuals interested in musical composition, performance, practice and scientific inquiry. Our goal is to create a common ground where music, cognitive science, computer science, and other disciplines meet to investigate, invent and implement creative tools for the next century.

2 Facilities

This year CNMAT's infrastructure benefited from the completion of a versatile internal wiring system. The balanced, patchbay-based system allows easily-reconfigured audio and video connectivity between studios, labs, performance spaces, classrooms, private offices, and a new, sound-isolated machine room. A recent concert employed five computers in three different rooms to simultaneously supply live interactive audio to the main concert space.

The recording studio has been upgraded with an ADAT-XT, a high-performance Silicon Graphics audio workstation, and numerous rack-mounted synthesis and signal control units. These tools, combined with a unique listening environment using Meyer monitors, custom-designed bass traps, and quadratic residue diffusers [3], have resulted in a favored workspace among faculty and visiting composers.

Other studios include an analysis lab (for studying audio samples in a high-quality listening environment), an interactive lab (for composer/performers developing new works and studying gestural control), a graduate student research lab (for research and development of audio software) and a visiting scholars' room (for special projects by foreign graduate students and post-doctoral researchers).

The main performance space is the center of all CNMAT's various activities, serving as a classroom, concert hall, meeting room and lab. This room combines permanent features such as Meyer speakers, built-in quadratic residue diffusers, and wall-mounted stage boxes with new portable mixing consoles and workstations to provide a flexible environment.

3 Composition and Performance Program

The Center hosts a variety of concerts each year. This year's focus was on new music that made use of CNMAT's composition and performance software. Composers and performers used CNMAT's latest tools for robust, real-time additive synthesis, new gestural interfaces, and other innovations from our research program. A selection from our performance program includes:

3.1 Duo: Shafqat Ali Khan, vocals and David Wessel, interactive instrumentation

This concert featured vocalist Shafqat Ali Khan, whose North Indian/Pakistani classical vocal music was embellished with Reson8 hardware and software. David Wessel performed rhythmic and harmonic accompaniment using CNMAT Additive Synthesis software [1] driven by a Thunder controller, and Matthew Wright played a tambura-like additive synthesis drone instrument of his own design controlled with a Wacom digitizing tablet [4].

3.2 Eye on CNMAT: The Body, Interactivity, and Improvisation

Three consecutive performances of a challenging and provocative program of new music premieres. Toronto composer Ron Smith played a selection from *Meditations*, his work in progress using CNMAT analysis and synthesis techniques to disassemble, manipulate, recombine, and control instruments such as the gamelan, suling, and vocal tracks. Michael Zbyszynski performed his piece *Strange Attraction II* for WX-7 wind controller and computer-generated accompaniment. CNMAT composer-in-residence Edmund Campion performed his work *Natural Selection II*, an evolving solo piano work (commissioned by IRCAM in 1996) that combines acoustic piano with real-time interaction. Quadratic sound spatialization for each piece was conceived and performed by Matthew Wright using LCS hardware and custom software. Graduate students Greg Pitter and Tom Swafford also presented works.

3.3 Fanfare for the New Century

Composer Olly Wilson, using CNMAT additive synthesis technology and LCS spatialization, opened the University of California's Capital Campaign kick-off event with *Fanfare for the New Century*, a work for brass quintet and eight-channel spatialized sound.

3.4 Other Composers

Other composers from within the UC Berkeley Department of Music and invited composers from around the world made use of CNMAT's exceptional facilities for their work. In addition to Ron Smith, Edmund Campion and Olly Wilson, this year CNMAT hosted composers Richard Felciano, Cindy Cox, Steve Clark, Andre Serre and others.

4 Education Program

As part of the UC Berkeley system, CNMAT draws students from a variety of backgrounds and disciplines and serves as a classroom for undergraduate courses on music and technology, music perception and cognition, and other advanced topics. New workstations for undergraduate and graduate students were created this year using Silicon Graphics and Apple hardware with CNMAT software and other audio processing applications. A revitalized version of our popular Music and Technology course was held in the fall, culminating in a student concert of innovative projects.

Graduate students taking courses and pursuing research at CNMAT come from departments within UC Berkeley and universities around the world. This year CNMAT graduate students continued their research into diverse areas such as rhythm software (inventing flexible and powerful ways to represent, construct, and perform rhythm-oriented music), intelligent instruments using neural networks, an analysis of public funding systems for 20th century music performance, and new graphical interface designs for audio analysis, experimentation, and control.

CNMAT also hosts seminars, colloquia, and lectures. Recent presentations have included a demonstration of new technologies for music (CNMAT staff), a composition presentation by visiting composer Joshua Fineberg, and a demonstration and talk by Eric Singer, Sabrina Liao and Clilly Castiglia from New York University's Media Research Laboratory (MRL) and Center for Advanced Technology (CAT). CNMAT also nominated and won an invitation for noted acoustician Rene Causse to present a series of lectures at the Center as a Regents' Lecturer. He will be in residence at CNMAT during the coming academic year.

5 Research Program

The CNMAT research program pursues inquiry, innovation and invention on several fronts, using the latest scientific and research tools to explore sound synthesis, analysis, performance controls, software, and sound diffusion. CNMAT research activities attract both students and professionals, allowing the energies from the academic and business worlds to complement and inspire one another.

Current projects include:

I. Robust Sound Analysis: new tools and methods, featuring harmonic-based analysis software, analysis/modeling of residual (noise) components, statistical methods, resonance analysis models, and timbral prototypes.

II. High Quality, Reactive, Real-Time Sound Synthesis: embedded processors and software, featuring real-time synthesis tools, additive synthesis implementations, SDIF (Spectral Description Interchange Format), OpenSynth (portable synthesis framework), cross-platform user interfaces, and interactive tools to manipulate data and models.

III. Intelligent Instruments: neural networks and gestural interfaces. Synthesis control involves the mapping of input gestures to the parameters that control the details of sound synthesis and compositional algorithms. These mappings are most often non-linear and, as in the case of additive synthesis, usually involve a large number of synthesis parameters that must be generated from those few parameters extracted from the gestures. Neural networks provide a mechanism for this "few to many" parameter mapping problem and are being actively explored for purposes of real-time control.

IV. CNMAT Rhythm Engine Project. Rhythmic organization has with few exceptions been neglected by music theory. In response to this neglect, CNMAT's rhythm project has developed a novel representation for the rhythmic structure applicable to a very broad spectrum of musical styles. This representation, presented elsewhere in this ICMC 97 conference [2], not only facilitates interactive real-time control of complex rhythmic structures but also provides a model that can be used for the perceptually meaningful analysis of rhythmic structure.

V. CNMAT Guitar Innovation Group: G.I.G. A long-term, concentrated research effort to explore new ways of thinking about, designing, playing, and experiencing the guitar. The project brings CNMAT together with industry partners to maintain an extended, interdisciplinary research and development focus on the instrument, enabling fruitful collaborations between experts in relevant disciplines, including musical performance and composition, acoustics, mechanical engineering, electrical engineering, sensor technology, computer science, and cognitive science.

VI. CNMAT Digital Positive - Organ Project. Using spectral modeling synthesis and sound diffusion techniques, the Digital Positive represents a completely new keyboard instrument with an exceptional timbral palette and a flexible control structure afforded by computer software. This "virtual organ" will be a remarkable teaching tool for organists and composers, allowing exploration of registrations of music and obviating many hours working with a potentially distant and hard to access organ. It will also serve traditional organ builders for voicing "virtual" pipes, mixtures and physical layout before construction of a real instrument.

VII. Source Model Loudspeakers. This project pursues the development of a loudspeaker system that is concentrated in a small and single location and that has a programmable radiation pattern. An amalgam of digital signal processing and loudspeaker technologies, the system allows for time-variant control of the polar radiation pattern as a function of frequency and is capable of simulating the radiation characteristics of acoustic instruments that vary in dramatic ways with the musical materials.

6 Personnel

Under the guidance of Richard Felciano, Founder and David Wessel, Director, CNMAT staff includes Adrian Freed, Research Director, Matthew Wright, Musical Applications Programmer, and Richard Andrews, the Center's new Administrator. CNMAT is also pleased to introduce our new composer-in-residence Edmund Campion, a distinguished composer and faculty member of the UC Berkeley Department of Music.

Our roster of active researchers includes Jeff Bilmes, Amar Chaudhary, Sophie Donnadieu, Cyril Drame, Todd Hodes, Rafael A. Irizarry, Vijay Iyer, Tristan Jehan, Sami Khoury, Tibor Knowles, Pierre Korzilius, Andreas Luecke, and Laetitia Sonami.

Our web site (http://www.cnmat.berkeley.edu) has been recently redesigned, showcasing all of our performance, research, and education programs.

7 Acknowledgments

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References

[1] Freed, A. 1995. "Bring Your Own Control to Additive Synthesis," Proc ICMC, Banff, Canada, pp 303-306.

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[3] Schroeder, M. 1997. *Number Theory in Science and Communication : With Applications in Cryptography, Physics, Digital Information, Computing, and Self-Similarity,* 3rd Edition. New York: Springer-Verlag.

[4] Wright, M., and A. Freed. 1997. "New Musical Control Structures from Standard Gestural Controllers," Proc ICMC, Thessaloniki.