

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

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## Abstract

*The Center for New Music and Audio Technologies (CNMAT) is an interdisciplinary research center within the Department of Music at the University of California, Berkeley. With an orientation towards live performance and interactivity, the Center houses programs in education, research, and composition/improvisation. CNMAT's goal is to provide a common ground where researchers, artists, and scholars can work together to address problems and issues in music technology for live music making. A major development in the past year was the launching of a new concert/performance series called TEMPO: The Berkeley Festival of Contemporary Performance. This multi-evening event, which is planned to be held every other year, features a variety of performers and composers who use technology in widely different ways to accomplish compositional and improvisational goals.*

## 1 Introduction

Established in 1989, CNMAT attracts students from music, computer science, electrical and mechanical engineering, psychology, statistics, and other disciplines at UC Berkeley. CNMAT provides a range of opportunities for students, professionals, and visiting scholars to engage in studies, conduct research, and participate in music performance projects.

## 2 Facilities

Many grants and equipment donations helped CNMAT expand its facilities this year. A Yamaha 02R mixing board with metering bridge was integrated into the sound spatialization theatre in our main room for concerts,

lecture/demonstrations, and research projects. A new multi-channel spatial audio system was installed in our recording studio, allowing composers to develop works involving spatialized sound. Several newly configured workstations were made available, with systems customized for hardware design and testing, music composition for film, audio dubbing and CD burning, and software development under Linux.

## 3 Education

The established curriculum offered at CNMAT includes Musical Applications of Computers and Related Technologies, Advanced Topics in Computer Music, Introduction to Computer Music Composition, Music Perception and Cognition, directed research and independent study.

### 3.1 New Compositions for Silent Films

Professor Edmund Campion launched a new collaboration with the Pacific Film Archive (PFA) and the Consortium for the Arts for students to create electro-acoustic music for silent films. The best pieces were chosen and presented in the regular PFA public schedule of projections.

### 3.2 Courses by Steve Coleman

Steve Coleman recently joined the faculty in the Department of Music and offered innovative classes in the theory and practice of improvisation. Coleman uses computer modeling of musical processes extensively in both his research and pedagogy.

### 3.3 Guest Lecturers

Guest lecturers included interdisciplinary artist Silya Kiese on the cross-pollination of music, installation art and sculpture, guitarist/ethnomusicologist Bob Brozman's lecture/demonstration *From Country Blues to Reunion Island Maloya and Sega Music*, and German composer/pianist Georg Graewe's series of lectures on the theme *Musical Strategies*.

### 3.4 Panel Discussion with San Francisco Symphony

In conjunction with the San Francisco Symphony's *American Mavericks* festival, CNMAT hosted *Switched-on Symphony? Technology and the Orchestra*, a panel discussion with Paul Lehrman, David Wessel, Edmund Campion, and Susan Key.

### 3.5 Other

Our international academic exchange program attracted talented visiting scholars such as graduate student Jeremy Marozeau from Ircam (France) and the École Polytechnique Fédéral de Lausanne (Switzerland) studying the perception of timbre and its interaction with pitch, and graduate student Alexander Jensenius from the University of Oslo (Norway) studying physical modeling, the new SAOL standard, and the creation of virtual instruments. Our popular summer workshops offer training in Max/MSP.

## 4 Performance and Composition

Live events continued to be a major focus of CNMAT's efforts. Many of the concerts featured results from in-house research projects.

### 4.1 TEMPO: The Berkeley Festival of Contemporary Performance

A major new concert series was produced by CNMAT this year. *TEMPO: The Berkeley Festival of Contemporary Performance* was held June 1-9, 2001 in Hertz Hall on campus and featured an international gathering of innovative musicians and composers in performances that blurred the lines between improvised and composed music. The list of artists included Steve Coleman and Five Elements; Roscoe Mitchell, George Lewis, Thomas Buckner, George Marsh, and David Wessel; an evening of

music by composer Edmund Campion; a performance by Shafqat Ali Khan, David Wessel, Matthew Wright and Ali Momeni; the Berkeley Contemporary Chamber Players conducted by David Milnes; guitarist/composer John Schott; and John Abercrombie, George Marsh, Rich Fudoli and Mel Graves. The music encompassed a wide range of musical styles, from contemporary concert music to jazz to ragas, while incorporating computer music technologies developed at CNMAT (<http://www.tempofestival.org/>).

### 4.2 New Work by Ronald Bruce Smith

Ronald Bruce Smith's *Constellation* for orchestra and live electronics was premiered by the Berkeley Symphony Orchestra, conducted by Kent Nagano. This new work featured real-time control by a human performer of custom synthesis and sound spatialization with innovative rehearsal and performance techniques (Madden, et al., 2001).

### 4.3 New Works by Edmund Campion

CNMAT Composer-in-Residence Edmund Campion created *Corail*, a new work for live electronics and roaming saxophone, that was written for saxophonist Vincent David and performed at both the TEMPO festival in Berkeley and Ircam's Agora festival in Paris. He also composed *Sons et Lumieres* for video projection (films of the Lumiere brothers), Yamaha disklavier, and 8 channel tape. Performances of Campion's works included *Losing Touch* (Berkeley, Sacramento, Texas, New York City), *Mathematica* (Brandeis University), and *Domus Aurea* (soloists of the Ensemble Intercontemporain, Paris).

### 4.4 Other

Graduate student composer Ali Momeni created *SriniHaVaNas* for guitar, percussion and live interactive electronics. The piece, featuring guitarist John Schott, exploited many research results from CNMAT's labs, including new guitar effects.

Invited composer/pianist Georg Graewe's *Berkeley Project* included concerts with George Marsh, percussion and David Wessel, live electronics.

Other concerts at CNMAT included Kotoist Miya Masaoka with pianist Vijay Iyer and saxophonist Aaron Stewart; performance artist Bob Ostertag; Pauline Oliveros with Philip Gelb, Dana Reason and Jon Raskin; Shafqat Ali Khan with Salar Nadir Khan, tabla; guitarist/ethnomusicologist Bob Brozman; guitarist Seth Josel;

composer/performer Alvin Curran; flutist Cecile Daroux with Nicolas Verin, electronics; Vijay Iyer, piano with J.D. Parran, reeds, and David Wessel, live electronics; Shira Kammen, violin, Allaudin Mathieu, piano, and Devi Mathieu, voice; and Moritz Eggert, piano.

Outside concerts supported by CNMAT included the Berkeley Contemporary Chamber Players with guest artist Steve Reich, and the San Francisco Contemporary Music Players performing the music of Jonathan Harvey.

## 5 Research

CNMAT's ambitious research agenda continues to explore a wide variety of topics in software, hardware, integration, interactivity, and live performance issues. For details, visit the research section of CNMAT's web site: <http://www.cnmat.berkeley.edu/research/>.

### 5.1 Scalable Connectivity Processor for Computer Music Performance Systems

After going through several revisions and improvements, this device (Avizienis, et al., 2000) was produced in limited quantities for beta-testing by our peers in the computer music research community. Testing in live performance situations is ongoing, as is the refinement of the device's design and functionality.

### 5.2 Analog Sub-System

A new Analog Sub-System had been added to the Connectivity Processor, providing 32 channels of configurable A/D converters and anti-aliasing filters with adjustable frequency and offset. This device is designed with a general, open-ended input, allowing users to connect with maximum flexibility via header pins. It also provides a prototyping area with op-amps and links to the Connectivity Processor via a 50-pin connector.

### 5.3 Hexaphonic Guitar effects

New hexaphonic guitar effects developed under a sponsored research grant from the University of California and Gibson Guitar Corp. include aggregate delays (pitch tracking with spatialization), a hexaphonic harmonizer with arbitrary interval generation and pitch tracking, pitch-synchronous delay effects, infinite sustain with real-time granular synthesis, and innovative uses of pedals, switches, and other controllers.

### 5.4 Guitar Pickups

Guitar pickup design and testing was done in collaboration with RMC Pickups in Berkeley. A new piezoelectric pickup was developed that generates four signals per string and allows new ways to study guitar string behavior.

### 5.1 Speakers

Speaker research includes a new study of speaker arrays in collaboration with Meyer Sound Laboratories. This project looks at radiation patterns of single drivers and seeks to understand and make predictions about radiation patterns of arrays using Meyer Sound's Multipurpose Acoustical Prediction Program (MAPP).

### 5.5 Statistical properties of tone profiles and melodic processes

This project by David Wessel and David Steinsaltz seeks to develop a unified, coherent model for tone profiles which are viewed as probability distributions on pitch classes and melodic processes that operate on intervals.

### 5.6 Gestural Interfaces

Our continued work on controllers such as the Tactex MTC Express included development of a geometric gesture scheme that controls spatial diffusion along with other parameters, gesture mapping that allows performers to navigate both within and across sinusoidal track models, and a mixing scheme based on pressure (Wessel and Wright, 2001).

### 5.7 Open Sound Control (OSC)

Although Open Sound Control was developed to control a sound processing application from another machine across a network, we have found many benefits of using OSC within a sound processing application to improve abstraction and manage complexity (Wright, et al., 2001).

### 5.8 Other

Graduate student Amar Chaudhary's contributions included performance measurements of additive synthesis and resonance modelling on current Intel processors, listener evaluation of reduction strategies for sinusoidal and resonance models (Chaudhary, et al., 2001), and completion

of his doctoral dissertation research that involved developing perceptual scheduling algorithms that gracefully trade audio quality for computational bandwidth in real-time additive synthesis and resonance modeling applications (Chaudhary, 2001). Graduate student Peter Kassakian continued his work on smart manipulation of amplitude envelopes by means of switching Kalman filters. Visiting scholar Dominique Richard developed a study of space, spatiality, music and the body. Other research projects include an extensible editor and viewer of SDIF sound representations and use of the Max/MSP environment to write SDIF files.

## 6 Personnel

Richard Felciano, Founder; David Wessel, Director; Adrian Freed, Research Director; Matthew Wright, Musical Systems Designer; Edmund Campion, CNMAT Composer-in-Residence and Assistant Professor, Music; Steve Coleman, Associate Professor, Music; Richard Andrews, Associate Director. CNMAT's list of researchers includes Rimas Avizienis, Amar Chaudhary, Richard Dudas, Alexander Jensenius, Peter Kassakian, Ahm Lee, Jeremy Marozeau, Tim Madden, Dominique Richard, Ron Smith, Takahiko Suzuki, and Brian Vogel. Evan Kumar Fiske is CNMAT's Administrative Assistant. Our roster of graduate student composers includes Keeril Makan, Ali Momeni, Alan Tormey, Dmitri Tymoczko, and Mei-Fang Lin.

## 7 Acknowledgements

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