CCRMA Studio Report

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Center for Computer Research in Music and Acoustics (CCRMA),
Stanford University

1.   Who we are

The Stanford Center for Computer Research in Music and Acoustics (CCRMA) is a multi-disciplinary facility where composers and researchers work together using computer-based technology both as an artistic medium and as a research tool (correct, but sort of stuffy: in other words, we use computers, we do research, we do music, we have fun).

CCRMA is located on the Stanford University campus in a building that was refurbished in 1986 to meet its unique needs. The facility includes a large multichannel/ multimedia experimental space with adjoining control room/all digital studio, a recording studio with adjoining control room, a MIDI-based small systems studio, a general purpose analog/digital studio, several work areas with workstations, synthesizers and speakers, a seminar room, a reference library, classrooms and offices.

For a detailed tour and more information feel free to visit us in the World Wide Web at:

·   **http://ccrma-www.stanford.edu/**

The *Overview* section will give you a fairly detailed review of the latest research and music.

The CCRMA community consists of administrative and technical staff, faculty, research associates, graduate research assistants, graduate and undergraduate students, visiting scholars and composers, and industrial associates. Departments actively represented at CCRMA include Music, Electrical Engineering, Mechanical Engineering, Computer Science, and Psychology. CCRMA has developed close ties with the Center for Computer Assisted Research in the Humanities (CCARH), recently affiliated with the Department of Music.

Staff & Faculty: **Chris Chafe**-Associate Professor of Music, Director; **Jonathan Berger**-Associate Professor of Music (Interim co-Director 98/99); **Julius Smith**-Associate Professor of Music and Electrical Engineering (Interim co-Director 98/99); **Jay Kadis**-Audio Engineer/Lecturer; **Fernando Lopez-Lezcano**-Systems Administrator/Lecturer; **Heidi Kugler**-Secretary; **Max Mathews**-Professor of Music (Research); **Jean-Claude Risset** (Visiting Pro-

fessor of Music - Spring Quarter); **John Chowning**-Professor of Music, Emeritus; **Leland Smith**-Professor of Music, Emeritus; **John Pierce**-Visiting Professor of Music, Emeritus; **Jonathan Harvey**-Professor of Music; **David Soley**-Assistant Professor of Music; **Eleanor Selfridge-Field**-Consulting Professor of Music; **Walter Hewlett**-Consulting Professor of Music; **William Schottstaedt**-Research Associate; **Gary Scavone**, Technical Director (and Post-Doctoral Fellow in Acoustical Research)**; Dan Levitin**, Lecturer; **Marina Bossi**; Lecturer.

2.   What we do

Center activities include academic courses, seminars, special interest group meetings, spring and summer workshops, and colloquia. Concerts of computer music are presented several times each year, including an annual outdoor computer music festival in July. In-house technical reports and recordings are available, and public demonstrations of ongoing work at CCRMA are held periodically.

Research results are published and presented at professional meetings, international conferences and in established journals including the Computer Music Journal, Journal of the Audio Engineering Society, and the Journal of the Acoustical Society of America. Compositions are presented in new music festivals and radio broadcasts throughout the world and have been recorded on cassette, LP (ok, ok, not recently), and compact disk.

3.   What we play with

Currently supported platforms include NeXT computers, Intel PC's running both NextStep and Linux, Silicon Graphics workstations and Macintosh computers (support for NT is currently in the planning stages). All platforms share accounting information and files over the network through several servers. Over the last year we have added 7 more fast machines to the network, 6 HP Pentium II 266/333MHz and another O2 with digital multichannel support (after this last round of upgrades we have finally started to decommission some of the older NeXTs). Both Linux powered PCs and SGIs has proven to be extremely popular during the past year, specially because of matlab, and the lisp compositional environment and the snd sound editor (more

on this latter). The main servers have been successfully migrated to O2 workstations.

The whole network infrastructure has been completely redesigned from scratch. From a thinnet based, one collision domain, 10Mb/s network, ccrma has successfully migrated to a fully switched 100Mb/s full duplex backbone, feeding local hubs for the slower 10Mb/s machines and directly connecting all new workstations to the servers at 100Mb/s full duplex. The new structure also allows us to eventually upgrade the backbone to 1Gb/s ethernet. We are now ready to connect to the Stanford University Network at 100Mb/s, including high speed access to the new Internet 2 GigaPops. Kudos to the Karma Wiring Team which spent more than a week pulling wire through The Knoll and Trailer B and made this possible (Chris Chafe, Bill Schottstaedt, Juan Pampin, Patty Huang and myself). Especially interesting was the foray into the cavernous attic over the Third Floor of The Knoll... The combination of network and server changes have had a very positive impact in the performance of all machines.

Supported software in the unix world includes the CCRMA Lisp Environment (which includes Common Music, Common Lisp Music and Common Music Notation), the new Snd sound editor, the MusicKit and associated programs (in NEXTSTEP only) and tons of utilities and packages for research and music creation. The Macintosh world has a full complement of MIDI based tools and is mostly used for MIDI applications, notation and digital mixing (with hardware assist from Dyaxis II and ProTools systems in two of the studios).

MIDI-based systems include Yamaha, Roland and Korg equipment including Yamaha DX, TX, SY, TG and VL synthesizers, KX88 keyboard controller, Disklaviers, Korg WaveStations and Wavedrum, E-mu samplers and digital delays and effect processors. Also available are IVL pitch trackers, a Buchla Lightning MIDI controller, several Mathews Radio Drum controllers, MIDI patchers and drum machines from Yamaha and Roland. Jay Kadis has replaced the MIDI Studio mixer with a Mackie 24-8 console and the old MacIIfx has been updated to a much faster PowerMac 8600/300. Studio E has now a new 16 channel ProTools system with a core card, several DSP Farm cards, Two SampleCell II cards and an 888 interface. Genelec 1030's will be installed shortly and a new digital patch bay makes digital life easier. Another ProTools system with one DSP Farm card and an 882 interface will live alongside the Dyaxis II system in Studio D. A PowerMac 7100 will replace the IIfx. All three studios now have Teac DAx8 multichannel digital recorders.

CCRMA's recording studio has become a central part of the Music, Science and Technology program, as it is heavily used by students studying audio recording technology. The studio is centered around a Biamp Legend 20x16 console and patchbay with two Tascam DA-88s, a Tascam 80-8 w/ dbx, and a Yamaha DMR-8 providing both analog and 16- and 20-bit digital recorders. A Spectral Translator format converter allows digital transfers between the different digital recorders. (An ADAT-XT is available for transfers and two Nakamichi MR-1s allow cassette recording.) Monitor systems include Westlake BBSM-10s powered by Hafler P-235s and JBL 4206s powered by a QSC 1080. Outboard gear includes Teletronix LA-2A, dbx 166, and Behringer Composer compressors, two Yamaha SPX-90IIs, a Yamaha SPX-1000, a Korg A-1, two Yamaha D1500 delays, two Rane GE-30 graphic equalizers, and Yamaha Rev-7 and Lexicon 224XL reverbs. Microphones include a Neumann TLM-193, AKG C-414s and C-460s, Electrovoice RE-20s, Sennheiser MD-421 and MD-504s, a Beyer M-500, and several Shure Beta-57s and SM-57s. Also available in the recording studio is a Yamaha DC-7 Disklavier piano.

4.   What we are looking for

This array of brief research and music summaries will give you an idea of the current crop, and who's doing it:

Computer Music Hardware and Software:

- "Common Lisp Music and Common Music Notation", "The *snd* Sound Editor" **- William Schottstaedt -** Bill says: "The main things I've done in the last year (since last August): added multi-host with-sound in CLM; wrote sndlib, including ports to Windows, Mac, HPUX, etc; added an envelope editor to Snd; Linux/SGI support for 4 or more channels; added a complete music symbol font to CMN. Many other small things like the transform-type menu in Snd, or improved src in both Snd and CLM.**"**

Aspects of MIDI and Controllers

- "New Radio-Baton Interface and Improvisation Software" - **Max V. Mathews**

- "MIDI_Sculptor: A Software System for Controlling MIDI Devices with the Radio Baton and Computer Keyboard" - **Nicholas Hind**

- "C++ Environments for Algorithmic Performances using MIDI" - **Craig Sapp**

- "Mi_D Everywhere. An Easy-To-Use, Multi-Platform MIDI Library" - **Tobias Kunze**

- "Optical Recognition of Printed Music: A New Approach" - **Walter Hewlett**

Voice Analysis/Synthesis, Pitch Detection, & Virtual Analog Synthesis:

- "Articulatory Voice Synthesis" - **Hui-Ling Lu**
- "Recovering the Articulatory Trajectories from the Acoustic Data of Speech" - **Yoon Kim**
- "Vocal Pitch Detector using a Capacitive Sensor of Throat Vibrations based on a Theremin Technology" - **Max V. Mathews and Andrew Aeinaudi**
- "Wave Digital Filters: A Brief Introduction" **- Stefan Bilbao**
- "Towards the Automatic Design of Variable-Pole Filters via Root-Locus Optimization" **- Tim Stilson**
- "Nonlinear Digital Modeling for Virtual Analog Synthesis" - **Harvey Thornburg**

Music Theory, Psychoacoustics, & Acoustic Archives:

- "Two Models of Melodic Expectation" - **Paul von Hippel**
- "An Amodal Gestaltist Critical Band Model of Perception" - **Sile O'Modhrain & Jonathan Berger**
- "A Computational Model of Meter Cognition during the Audition of Functional Tonal Music: Modeling a-priori Bias in Meter Cognition" - **Jonathan Berger**
- "A Multidimensional Model for Perceptual Evaluation of Audio Codecs" - **Kristin Precoda**
- "The Musical Acoustics Research Library" - **Gary P. Scavone**

Physical Modeling & Virtual Acoustics:

- "Scattering within Conical Waveguides" - **Dave Berners**
- "Efficient Digital Waveguide Modeling of Piecewise-Conical Bores and Flared Horns" **- Julius Smith & Maarten van Walstijn**
- "Real-time Computer Modeling of Woodwind Instruments" **- Gary P. Scavone -** he is continuing his work modeling woodwind instruments. He has developed an efficient method of modeling toneholes and register holes for real-time performance. He has also constructed a wind controller which allows each tonehole and register hole to be controlled independently, with 128 states from fully open to fully closed.
- "3-D Audio and Virtual Acoustics in Future Multimedia Systems" - **Jyri Huopaniemi**
- **Julius Smith** gives us a round up on his current activity: In the past year he has worked (to widely varying extents) on modeling of horn flare with **Dave Berners**, extended sinusoidal modeling of audio signals with **Scott Levine and Tony Verma**, optimal digital interpolators with **Bill Putnam**, virtual analog algorithms with **Tim Stilson**, truncated IIR filters with **Avery Wang**, efficient filter structures for horn reflectances with **Maarten van Walstijn** (for Staccato Systems), tonehole modeling with **Gary Scavone**, warped wave digital filters with **Stefan Bilbao**, auditory frequency warpings with **Jonathan Abel**, piecewise conical bore modeling, nonlinear commuted synthesis of bowed strings, guitar synthesis algorithms (for Staccato Systems), SynthBuilder (for Staccato Systems), and software for Perry Cook's Synthesis Tool Kit (STK). Most recent papers are available on the web in postscript and/or pdf and/or html formats at http://www-ccrma.stanford.edu/~jos/.

Synthesis and DSP: Techniques and Tools:

- "Vicarious Synthesizers: Listening for Timbre" **- Chris Chafe**
- "Real-time Synthesis and Sound Processing Using Common Lisp Music" **- Juan Pampin -** The live electronics part of "*Mantra*" by Karlheinz Stockhausen was implemented using real time CLM processing and performed in concert (first performance we know off of the electronic part being played by a general purpose computer).
- "Connected to What?" (Cognition in Music Theory) (SMT Plenary - 1997) **- Jonathan Berger**
- "Signal Processing Concepts in Mathematica" - **Craig Sapp**
- "Flowgraph-based Object Oriented Signal Processing in C++" - **Craig Sapp**
- "Perceptual Audio Coding Based on the Sinusoidal Transform" - **Guillermo Garcia and Juan C. Pampin**

Some of the recent (during this past year) compositional works realized at CCRMA:

- **Jonathan Berger** (Associate Professor of Music)**-** Received Chamber Music of America Millennium commission for a work for computer and chamber ensemble, *Arroyo*, for motion tracked dancer, computer, and instruments (commissioned by the Instituto Nacional de Bellas Artes) was premiered in Mexico City and Guanajuato, Mexico; *Piano Concerto* premiered by the Moscow Symphony in Moscow and Rjeka, and will be performed in the Fall in Paris and Moscow; Premiered *Elegy* for alto and chamber ensemble (commissioned by the Jerusalem Rubin Academy of Music)
- **Chris Chafe** (Associate Professor of Music) **-** "*Whirlwind*" for viola and live electronics.
- **Joanne D. Carey** (Visiting Composer) **-** "*Adventures on a Theme*" for Flute and Radio-Baton in three movements: *The Unraveling*, *Topsy Turvy* and *Haywire Harmony Rains*.

- **Janet Dunbar** (DMA Graduate Student) **-** *Song of the Sea*, for performance poet and soprano.

- **Jonathan Harvey** (Professor of Music)**- Juan Pampin** (PhD Graduate Student) **(collaboration) -** *Ashes dance back*, for choir and electronic sounds.

- **Jun Kim** (DMA Graduate Student) - *Eum-Yang* for New Piano Trio (Radio Baton, Celleto and Disklavier).

- **Bobby Lombardi** (DMA Graduate Student) - *Sermont on the Mount*, for two channel tape.

- **Fernando Lopez Lezcano** (System Administrator / Lecturer)- *House of Mirrors* for PadMaster, Radio Drum, midi instruments and soundfile playback. I*i*CE *s*C*c*R*r*E*e*A*a*M*m* for multichannel sound playback.

- **Charles Nichols** (PhD Graduate Student) **-** *Regulate Six*, for MIDI violin and computer.

- **Ron Alford** (Visiting Composer) **-** *girltalk*, for stereo tape.

- **Jonathan Norton** (PhD Graduate Student) - *20 Questions*, for tape; *Cloud Nine*, for tape; *Suite for Mallet-KAT and Percussion*, three movement piece for MalletKAT controlled Yamaha TG77 and vibraphone.

- **Juan Pampin** (PhD Graduate Student)**-** *Toco Madera*, for wooden percussion and electronic sounds, *Skin Heads* for percussion trio and electronic sounds.

- **Chris Falk** (DMA Graduate Student)**-** *Time Echoes,* for viola and tape.

- **Oded Ben-Tal** (DMA Graduate Student)**-** *Two studies after Sibelius* for stereo tape.

- several works in progress by **Marek Zoffaj, David Soley, Ching-Wen Chao**, **Seungyon-Seny Lee**, **Kotoka Suzuki** and others.