6. BRIEF HISTORY

Center for Computer Research in Music and Acoustics
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INTRODUCTION

The Stanford Center for Computer Research in Music and Acoustics (CCRMA) is an interdisciplinary facility where composers and researchers work together using the computer-based technology as a new musical and artistic medium, and as a research tool. It is one of the major new music resource centers in the world. Other centers include IRCAM in Paris; CME at the University of California, San Diego; the Experimental Music Studio at MIT; the recently established Center for New Music and Audio Technology at the University of California, Berkeley; the University of Toronto; Colgate University; STEIM in Amsterdam; and the Swiss Center for Computer Music in Geneva.

Areas that support musical activities at CCRMA include: Applications Hardware, Applications Software, Synthesis Techniques and Algorithms, Signal Processing, Digital Recording and Editing, Psychoacoustics and Musical Acoustics, Physical Modeling of Instruments, Applied Pattern Recognition and Artificial Intelligence, Music Manuscript by Computer, Composition and Real-Time Applications with Small Systems.

The CCRMA community consists of administrative and technical staff, faculty, composers, research staff, graduate and undergraduate students, visiting professionals and composers, and industrial associates. Major departments actively represented at CCRMA include music, electrical engineering, computer science, and psychology.

Center activities include academic courses, seminars, small interest group meetings, summer workshops and presentations. Concerts of computer music are presented each quarter with 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 monthly during the academic year.

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, and compact disk.

Support for CCRMA has been received from the California Arts Council, the National Endowment for the Arts, the National Science Foundation, the Rockefeller Foundation (for artists-in-residence), the System Development Foundation, Doreen B. Townsend, Apple Computer, Dynacord, New England Digital, Sequential Circuits, Symbolics, Xerox Palo Alto Research, Yamaha, and private gifts. Composers at CCRMA are supported by Guggenheim grants, Fulbright grants, NEA composer fellowships, Harkness fellowships, DAAD grants, and grants from various government agencies.

Works produced at the Center have been presented in concert and broadcast on radio throughout the U.S., in Europe, Japan, Australia, and South America and have won numerous awards. They will be represented in 1989 at concerts in New York, St. Louis, the International Computer Music Conference in Ohio, Italy, Essen, West Germany, Czechosolovkia, Norway, and South America. Interviews and presentations of the work at CCRMA have been presented in Keyboard Magazine, Mix Magazine, Electronic Musician, the Smithsonian Magazine, on Public Television, National Public Radio, in National Geographic Films, on NBC, and in documentary films in Switzerland, Germany, Austria, France, and the U.S.

Recent and current projects at the Center include a collaboration with composer Dexter Morrill and jazz musician Wynton Marsalis, a musical theater piece by composer Janis Mattox in conjunction with the Djarassi Foundation; a work for computer and digital keyboards by composer John Chowning; a chamber

opera work by composer David Jaffe; a work for string quartet and computer tape by composer Ira Mowitz; a work for celletto and live computer by composer Fred Malouf; a work for celletto and computer by composer Chris Chafe; a work for oboe and live electronics by composer Todd Winkler; a work for soprano and radio drum by Richard Boulanger in collaboration with Max Mathews; a work for computer music, performers, chorus and instruments by composer Larry Austin; and a work for narrator, percussion, and computer tape by composer Amnon Wolman.

Brief History of CCRMA

In 1964, while pursuing graduate studies with Professor Leland Smith, John Chowning began the work in computer music at Stanford using Music IV with help from Max Mathews of Bell Telephone Laboratories. Initial experiments were carried out with the help of the Computer Science Department on their time-sharing computer system (an IBM 1790 and a DEC PDP-1). Together, Chowning and computer science student David Poole put together the first on-line computer composition and synthesis system, with technical help from Computer Science and Electrical Engineering. As a result, John Chowning wrote the first programs for moving sound sources through a four-speaker space. As part of this project, a 12-bit DAC with a multiplex of four outputs was built. The program had both angular and distance cues, reverberation and Doppler shift.

In 1966, the Stanford Artificial Intelligence Laboratory moved to the D.C. Power Laboratory Building on Arastradero Road and acquired a DEC PDP-6 computer. Music 10, a music compiler for the PDP-6, was written by David Poole. It was at this same time that Chowning joined the music faculty teaching music theory and computer music, and the first course in computer–generated music was offered.

Exploratory work on musical timbres began in 1967 and led to the discovery of the use of frequency modulation (FM) for sound synthesis by John Chowning with the help of David Poole and engineering graduate student George Gucker .

In the summer of 1969 the first summer workshop in computer-generated music was taught by John Chowning, Leland Smith, Max Mathews and George Gucker.

The work in FM synthesis resulted in the composition "Sabelithe," written in the spring of 1971, and the publication of Chowning's paper on FM synthesis, which appeared in the Journal of the Audio Engineering Society in September 1973. The FM synthesis technique was licensed to Nippon Gakki, Inc. (Yamaha) in 1974, and the development of electronic music instruments based on FM synthesis was begun in Japan with consultation from Stanford. A patent for FM was granted in 1977. Other basic work by Leland Smith included the development of SCORE, a computer program written in FORTRAN which enabled composers to synthesize and compose pieces using the DEC PDP-6 and later the PDP-10; and MS, a music manuscripting program which has been highly developed over the years and is now available for use on personal computers.

Working on dissertations in the area of computer music, James A. Moorer, Loren Rush, John Grey, and F. Richard Moore made important contributions to the field in analysis-synthesis, digital editing, and synthesis hardware. In 1972, John Grey and Andy Moorer began working on the analysis and resynthesis of real instrument tones by computer. This work led to important discoveries about the psychoacoustics and perception of sound. In 1968 Loren Rush began working in the area of digital recording using programs written for speech research. Working with Andy Moorer and Ken Shoemake, in 1974 he completed EDSND, a program for computer editing of recorded sound, and in 1976 the first high quality digital recordings were made.

Early compositions from CCRMA included: "Sabelithe I" for sound and 3 performers by John Chowning in 1966 (never completed due to the Artificial Intelligence Laboratories move to the DC Power Laboratory Building); "Adosaman" for tape, by Irmfried Radauer in 1967; "Rondino" for stereo tape, by Leland Smith in 1968; "Pour" for sound and recorded voice, by Martin Bresnick in 1969; "Fragment" for stereo tape, by Martin Bresnick in 1970; "Sabelithe II" for quad tape, by John Chowning; "Machines of Loving Grace" for bassoon and narrator with stereo tape and "Rhapsody for Flute and Computer" for flute and stereo tape, by

Leland Smith in 1971; "Turenas" for quad tape, by John Chowning in 1972; "A Little Traveling Music" for amplified piano and quad tape, by Loren Rush in 1974; a realization of John Erickson's "Loops," by John Grey in 1974; and "Song and Dance" for orchestra and quad tape, by Loren Rush and commissioned by the San Francisco Symphony in 1975.

Because of their growing reputation, members of the computer music group at Stanford were asked by Pierre Boulez in 1973 to participate in the planning stages of his music research institute being formed as part of the Centre Pompidou in Paris. In August 1975, the IRCAM group came to Stanford to participate in a special workshop on computer music. The research relationship and exchange between the two centers has continued over the years.

In June of 1975, CCRMA was formed with funding provided jointly by Stanford University, by a gift from Mrs. Doreen B. Townsend, by a grant from the National Science Foundation for research, and by a grant from the National Endowment for the Arts for computing equipment for musical purposes. As a result, CCRMA was able to commission the design and fabrication of the Systems Concepts Digital Synthesizer (designed by Pete Samson and called the Samson Box) which was installed at CCRMA in 1977. Although a part of the Music Department at Stanford, CCRMA continued to share facilities and computing equipment with the Stanford Artificial Intelligence Laboratory (SAIL) of the Computer Science Department at the D.C. Power Laboratory Building on Arastradero Road. The founding co-directors of CCRMA were faculty members John Chowning and Leland Smith and research associates John Grey, James A. Moorer and Loren Rush.

Funded research at CCRMA at this time included work on "Timbre Perception for Complex, Time-Variant Tones" and the "Computer Simulation of Music Instrument Tones in Reverberant Space."

The first computer music concert ("An Evening of Computer Music and Film") was held August 10, 1976 at Dinkelspiel Auditorium and in 1978 CCRMA presented a concert of computer music at the Stanford Museum of Art.

Additional work accomplished at this time included the development of software for the Samson Box. The initial program was MBOX written by graduate student Gareth Loy in 1977-78 and resulting in his piece "Nekyia" in 1979. Subsequently graduate students, David Jaffe, Michael McNabb and Bill Schottstaedt revised and extended this software into a program called SAMBOX as a result of their own compositional work. In 1977 Marc LeBrun began work on waveshaping synthesis techniques. In 1978 Bill Schottstaedt began work on Pla, an interactive interpreter program which includes a graphics-oriented note-list editor. This program, written in SAIL, was first used in the composition of Schottstaedt's "Daily Life Among the Phrygians" and has become the main program used by composers at CCRMA for compositions that use the Samson Box digital synthesizer.

Another major accomplishment in 1977 occurred when graduate student Michael McNabb, using available software for the PDP-10 computer and additive synthesis, digitally applied the timbres of vocal sounds to instrumental sounds to achieve a smooth transition in timbre between the two. This work resulted in the composition of "Dreamsong" in 1979. This work also led to experiments by John Chowning applying this technique to FM synthesis (in Paris in 1979), which resulted in the composition of "Phone" in 1981, which in turn led to Stephen McAdams' dissertation work on spectral fusion.

This was a compositionally active period of time. Works written at this time include: "Dirge" and "Sinfonia for Computer" by Bill Schottstaedt and "Stria" by John Chowning in 1977; "Sandcastle," "Mars Music," "New Music Liberation Army," "The Gong Tormented Sea" and "You're So Far Away" by Bill Schottstaedt, "Mars in 3D" by Michael McNabb and Bill Schottstaedt, "Oracle - 4am" by Paul Wieneke and "Standing Waves" by Stuart Dempster in 1978; and "Nekyia" by Gareth Loy, "Dreamsong" by Michael McNabb, "the servent snapping eye..." by Roger Reynolds, and "Daily Life Among the Phrygians" by Bill Schottstaedt in 1979.

In November 1979, the Artificial Intelligence Laboratory moved to the Stanford campus to new facilities with the Computer Science Department. CCRMA remained at the D.C. Power Building and, with the help of Stanford University and Yamaha, obtained its own time-sharing computer system: A Foonly F2

3

(later upgraded to a Foonly F4) central processor with 256K of memory emulating a DEC PDP-10 and designed by David Poole, various computer peripherals, and several digital/audio workspaces. Extensive work was accomplished by Andy Moorer and Tovar in writing software for the new system. This included a comprehensive signal processing library for computer music applications by Andy Moorer. No longer having to share computers and work space with the Computer Science Department enabled CCRMA to become an independent and fully functioning center.

In 1980, CCRMA received a grant from the National Science Foundation (NSF) to begin work in the "Intelligent Analysis of Acoustic Signals." Initial work was begun by Loren Rush and Chris Chafe at CCRMA in conjunction with Joseph Rockmore and Bernard Mont-Reynaud at Systems Control Technology in Palo Alto. This work has continued at Stanford under the direction of Bernard Mont-Reynaud and with support from NSF.

In 1982, CCRMA received a major five year grant from the System Development Foundation for operating support and research. This grant enabled the center to obtain needed equipment and support staff. The Center was able to accommodate a larger number of composers, researchers, and students, and computer music at Stanford began to flourish.

Important work at this time included dissertations by Stephen McAdams, John Strawn, Jeff Borish, Christopher Sheeline, John Gordon, and Andy Schloss in areas of psychoacoustics, and Julius Smith on digital filters and physical modeling.

Work in the area of digital recording continued under the direction of Loren Rush. Software and hardware interfaces were extended to enable the direct digital transfer of sound between the Foonly and Sony PCM-F1 and PCM-1610 digital recorders. This work resulted in the mastering of "The Digital Domain", a compact disk demonstrating the capabilities of digital audio and released by Electra for Warner Special Products in January 1984. Other recording projects completed included "Michael McNabb: Computer Music", a digitially mastered phonograph disc reseased in 1984 and "Computer Music from CCRMA" produced by Janis Mattox.

In 1982 Julius Smith and David Jaffe began work on the synthesis of plucked strings using the Karplus-Strong plucked-string algorithm. This resulted in the composition of "Silicon Valley Breakdown" by David Jaffe in 1983 and has led to the exploration of other synthesis techniques based on physical modeling by Chris Chafe, David Jaffe, and Julius Smith.

Other compositions during this period included: "Towers of Hanoi" by Andrew Schloss and "Garden for Orpheus" by Paul Wieneke in 1980; "Phone" by John Chowning, "Attend" by Paul Wieneke, and "Voicespace IV" by Roger Reynolds in 1981; "Colony" by Bill Schottstaedt from 1981-1983 and "Book of the Burning Mirror" and "Dinosaur Music" by Bill Schottstaedt in 1983; "Diptych" for stereo tape, mezzo-soprarno and string quartet by Jonathan Berger, "gamelan R gong gong" by JoAnne Carey, "Mr. Normal and the Details" and "Red Cup and Rat (What's Wrong With This Picture?)" by Doug Fulton, "Bristlecone Concerto No. 2" for solo violin, solo mandolin, instruments and tape, and "Bristlecone Concerto No. 3" for mandolin, percussion and stereo tape, by David Jaffe, "Music for S" by Stanislaw Krupowicz, "Dialogos" by Servio Marin, "Shaman" for percussionist, dancer, bassist, vocalist, and tape by Janis Mattox, "Getz Variations" for tenor sax and tape by Dexter Morrill, "Anira" by Adolfo Nuñez, "Daybreak" by Bill Schottstaedt, "Pentateuch" for soprano, three choral groups, large orchestra and tape by William Sussman, "Areyto" for chamber orchestra and sound by Raymond Torres-Santos, and "Etude (Hommage a Bartok No. 2)" by Amnon Wolman in 1984.

In 1983, the university began to make plans to move CCRMA to the Stanford campus. With the completion of the Music Department's Braun Music Center, the former home of the Music Department, the Knoll, became available for CCRMA's use. (Built in 1916, the Knoll was originally the home of Ray Lyman Wilbur, president of the University. The Wilbur family lived in the building until the early 1940's when the building began to be used by the University for academic purposes.)

Renovation of the Knoll to provide CCRMA with facilities for interdisciplinary digital acoustic research and composition began in April of 1985. CCRMA moved to the Doreen B. Townsend Center for Computer Research in Music and Acoustics in the refurbished Knoll building at the end of March 1986.

The new facility includes a large computer room, a large quadraphonic experimental space with adjoining control room/studio, an all-digital recording studio with adjoining control room, a MIDI-based small systems studio, several work areas with terminals, personal computers, synthesizers and speakers, a seminar room, an in-house reference library, a classroom and offices. The building has been "hard-wired" so that any office or workspace can connect with the mainframe computer and synthesizer, Ethernet and AppleTalk. A network gateway connects to the campus at large and also to national and international networks.

CCRMA Faculty and Staff

John Chowning, composer/Professor of Music/Director
Patte Wood, Administrative Director
Heidi Kugler, Secretary
Chris Chafe, Technical Director/composer/Assoc. Prof. of Music(Research)
Jay Kadis, Audio Engineer
Max Mathews, Professor of Music(Research)
Bernard Mont-Reynaud, Assoc. Prof. of Music(Research)
John Pierce, Visiting Professor Emeritus of Music
William Schottstaedt, composer/Research Associate
Earl Schubert, Professor Emeritus of Hearing and Speech
Julius Smith, Assoc. Prof. of Music(Research)
Tovar, Systems Programmer