EE298-20 Digital Signal Processing Seminar
3:10 - 5:00 pm Friday, October 25 1996
Hughes Room, 400 Cory Hall

Please note that the seminar will start ONE HOUR EARLY at 3:10pm.

TITLE

SynthBuilder: A Rapid-Prototyping Tool for Sound Synthesis and Audio

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ABSTRACT

SynthBuilder is a user-extensible, object-oriented, NEXTSTEP Music Kit application for interactive real-time design and performance of synthesizer patches, especially physical models [Smith 1987]. Patches are represented by networks consisting of digital signal processing elements called unit generators and MIDI event elements called note filters and note generators. As an example of the kinds of patches developed, a six-string electric guitar model with distortion, feedback, and wah-wah can run in real time under SynthBuilder on a single 72Mhz Motorola 56002 DSP chip.

The Frankenstein box is a multi-DSP compute engine that was developed as a research platform [Putnam 1996]. It communicates with an x86 host via an ISA interface card that resides in the host computer. Frankenstein currently contains 8 Motorola 56002 Evaluation Modules (EVMs), and can be scaled to an additional 8 EVMs for a total of 16. The outputs of the EVMs can be sent to an external mixer.

SynthBuilder provides a graphical interface to building modular sound synthesis and processing patches using unit-generators (a technique pioneered for computer music by Max Mathews at Bell Labs in the 1950s [Mathews 1969]). The software is built on the NeXT Draw program and the NeXT Music Kit [Jaffe 1989, Smith 1989] which is an object-oriented library supporting music applications under NEXTSTEP combining the gestural control of MIDI with the timbral control of MUSIC V, extending both. SynthBuilder evolved from a prototype graphical application for creating MusicKit patches called SynthEdit [Minnick 1990] and a student project called GraSP by Eric Jordan at Princeton. Since 1993, SynthBuilder has been developed primarily by Nick Porcaro supported by the Stanford Office of Technology and Licensing, with significant contributions from David Jaffe, Pat Scandalis, Julius Smith, Tim Stilson and Scott Van Duyne.

SynthBuilder has been used at CCRMA as a physical modeling research and development tool, and as a synthesizer/effects processor in live performances. In 1994, 1995, and 1996, demonstrations were given at the ICMC [Porcaro 1996].

The current version of SynthBuilder, Beta23, was released to the Internet in September of 1996, and can be found at ftp://ccrma-ftp.stanford.edu/pub/NeXT/SynthesisTools/.

In this talk we will give an overview of the design of SynthBuilder and its underlying real-time DSP operating system, and demonstrate recent SynthBuilder features and patches including percussion, piano, guitars, harpsichords, and other instruments. Finally, we will discuss plans for the future which include porting to other platforms, an interchange format called SynthScript, and a portable server called SynthServer which will enable execution of SynthBuilder patches on other computers.

References

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[Smith 1989] Smith, J., D. Jaffe, L. Boynton, "Music System Architecture on the NeXT Computer", Proceedings of the 1989 Audio Engineering Society.

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BIOS:

Nick Porcaro was born 1961 in New York City. He received a B.S. degree in Electrical Engineering from Texas A&M University in 1984. In 1987 he moved to San Francisco and started the Haight Ashbury Free Band in which he played keyboards. Recently he has played some free jazz concerts with a group called alt.music.out, which incorporated live effects processing using SynthBuilder. From 1984 to 1993, Nick worked in the fields of electronic design automation, and geophysics as a software engineer. Since 1990, Nick has been a visiting scholar at CCRMA, where he has been the primary developer of SynthBuilder, a graphical software application for synthesizer patch development and effects processing. SynthBuilder has been used extensively at CCRMA for several research, composition and performance projects. SynthBuilder has been presented at the International Computer Music Conference in 1994, 1995 and 1996.

Pat Scandalis received a BS in Physics in 1983, from the California Polytechnic University, in San Luis Obispo. Pat's Senior Project work in 1982-1983 involved simulations of plucked strings and membranes. From 1983 to 1994, Pat worked in the field of Electronic Design Automation (EDA), as a software engineer/manager. From 1983 to 1985 he worked at National Semiconductor. From 1985 to 1990, he worked at Aida where he specialized in CAD languages for EDA. From 1990 to 1993, he contributed/managed the EDA, CAD Systems, and Design for Test (DFT) groups for Apple Computer's PowerPC system project, and from 1993 to 1994, he managed the Simulation CAD and DFT groups for Sun's UltraSPARC Microprocessor project. Since 1994 Pat has been a working at CCRMA, applying his experience with EDA systems to parts of SynthBuilder and more recently to SynthScript.

Julius O. Smith received the B.S.E.E. degree from Rice University, Houston, TX, in 1975 (Control, Circuits, and Communication Systems). He received the M.S. and Ph.D. degrees in Electrical Engineering from Stanford University in 1978 and 1983, respectively (Statistical Signal Processing). His Ph.D. research involved the application of digital signal processing and system identification techniques to the modeling and synthesis of the violin, clarinet, reverberant spaces, and other musical systems. From 1975 to 1977 he worked in the Signal Processing Department at ESL in Sunnyvale, CA, on systems for digital communications. From 1982 to 1986 he was with the Adaptive Systems Department at Systems Control Technology in Palo Alto, CA, where he workedin the areas of adaptive filtering and spectral estimation. >From 1986 to 1991 he was employed at NeXT Computer, Inc., responsible for sound, music, and signal processing software for the NeXT computer workstation. Since then he has been an

Associate Professor at the Center for Computer Research in Music and Acoustics (CCRMA), Stanford University, teaching courses in signal processing and music technology, and pursuing research in signal processing techniques applied to musical instrument modeling, audio spectral modeling, and related topics. An expanded CV can be found on the Web at http://www-ccrma.stanford.edu/~jos/.

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