SynthBuilder and Frankenstein
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Nick Porcaro (nick@ccrrma.stanford.edu),
William Putnam (Putnam@ccrma.stanford.edu)
Pat Scandalis (gps@ccrma.stanford.edu),
Tim Stilson (stilti@ccrma.stanford.edu),
David Jaffe (daj@ccrma.stanford.edu),
Julius Smith (jos@ccrma.stanford.edu),
Scott Van Duyne (savd@ccrma.stanford.edu),

CCRMA (http://www-ccrma.stanford.edu)

Overview:

SynthBuilder is a user-extensible, object-oriented, NEXTSTEP Music Kit application for interactive real-time design and performance of synthesizer patches, especially physical models [Jaffe 1983] [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.

SynthBuilder runs on original black NeXT machines as well as PC's running NEXTSTEP 3.3. On PC's SynthBuilder runs with the assist fo a DSP card. The most commonly available DSP card that SynthBuilder will run with is the Turtle Beach Tahiti card. I addtion to these cards, we have built a MultiDSP engine known as the Frankenstein Box. 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.

A Brief History of SynthBuilder and Frankenstein

The original concept of a unit generator-based digital audio synthesis language was pioneered by Max Mathews at Bell Labs in the 1950s, cumulating with the Music V program in the 1960s [Mathews 1969]

The NeXT Music Kit [Jaffe 1989][Smith 1989], developed by David Jaffe and Julius Smith is an object-oriented library implemented in Objective-C for the design of music applications for the NeXT computer. It combines the gestural control of MIDI with the timbral control of MUSIC V, while extending the flexibility of both.

In 1989, Michael Minnick, working at NeXT, developed a prototype graphical

application for creating MusicKit patches called SynthEdit, and presented a paper on it at the International Computer Music Conference [Minnick 1990].

Nick Porcaro started work on SynthBuilder in 1992. Initially, it was an extension of GraSP, a student project by Eric Jordan, created at Princeton University in 1992, with advisory assistance by David Jaffe who was teaching there at the time. Since 1993, Nick has extensively developed SynthBuilder with support from Stanford's Office of Technology and Licensing, with significant contributions from: David Jaffe, Pat Scandalis, Julius Smith, Tim Stilson and Scott Van Duyne. SynthBuilder also uses code from the NeXT Draw programming example, and some icons originally created for SynthEdit.

In the Summer of 1995, William Putnam and Tim Stilson, created the Frankenstein MulitDSP engine as a platform to support physical modeling research using SynthBuilder [Putnam 1996]. The original Frankestein contained 8 Motorola 56002 Evaluation Modules running at 40 MHz.

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].

SynthBuilder, Alpha30, was released to the Internet in December of 1994. The current version of SynthBuilder, Beta23, was released to the Internet in September of 1996.

In March of 1997 all the original developers of SynthBuilder formed a company called Staccato Systems, inc. to commercialize technology that they had developed at Stanford. The current version of SynthBuilder, Beta25 is known as Staccato SynthBuilder Beta25.

SynthBuilder and Frankenstein Today

The current version of SynthBuilder, Beta25, has been significantly optimized and extended, over the pervious version Alpha30. DSP allocation speed, memory usage and drawing performance have been greatly improved. Many new features have been added, including: sound file writing support for various Intel-based DSP cards, an improved driver for the Frankenstein box (an array of 8 Motorola 56002 DSPs), new unit generators and note filters, context-sensitive help, drop-in subpatches, subpatch variations, inspector improvements, a new trace window, and more robust help/tutorial. These features along with numerous bug fixes and paradigm refinements have enabled rapid development of complex patches.

The current version of Frankenstein, is now running at 72 MHz. We have also developed a single card/single EVM version of the Frankenstein, known as a "Cocktail Frank" that also runs at 72 MHz. It has been possible to implement a 6 string electric guitar model with wah-wah/distrortion and amplifier feedback model using this card.

SynthBuilder and Frankenstein Demonstrations

When we demonstrate SynthBuilder, we demonstrate recent SynthBuilder features, discuss physical model calibration, show recently-developed SynthBuilder patches; including percussion, piano, guitars, harpsichords, and others. The results of this Demonstration can be heard on the audio CD included.

We are porting our patches to other platforms. Toward this goal, we have developed an interchange format called SynthScript, and defined a portable server, SynthServer, which will enable execution of SynthBuilder patches on other computers. Part of the demonstration will present a SynthScript patch running on a native processor.

In the near future, we plan to continue to build more patches and improve SynthBuilder. We are also discussing porting to Windows NT/95.

References

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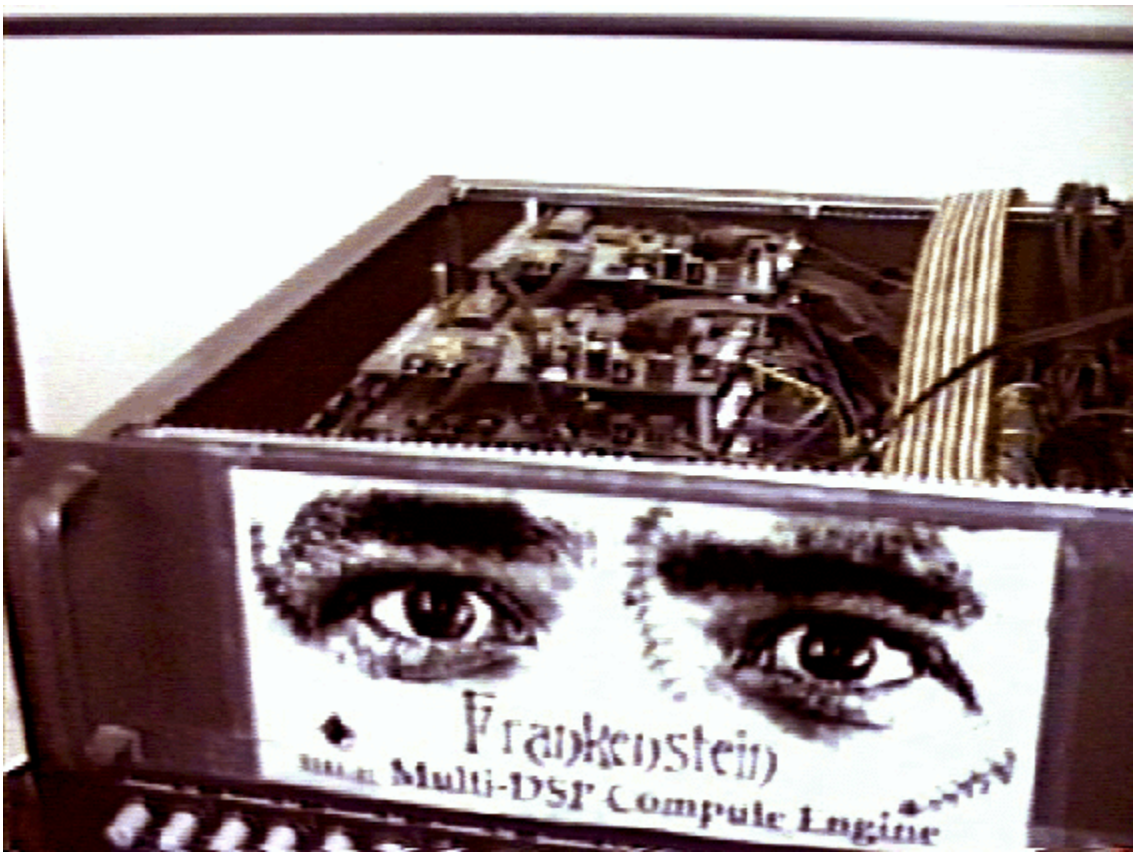
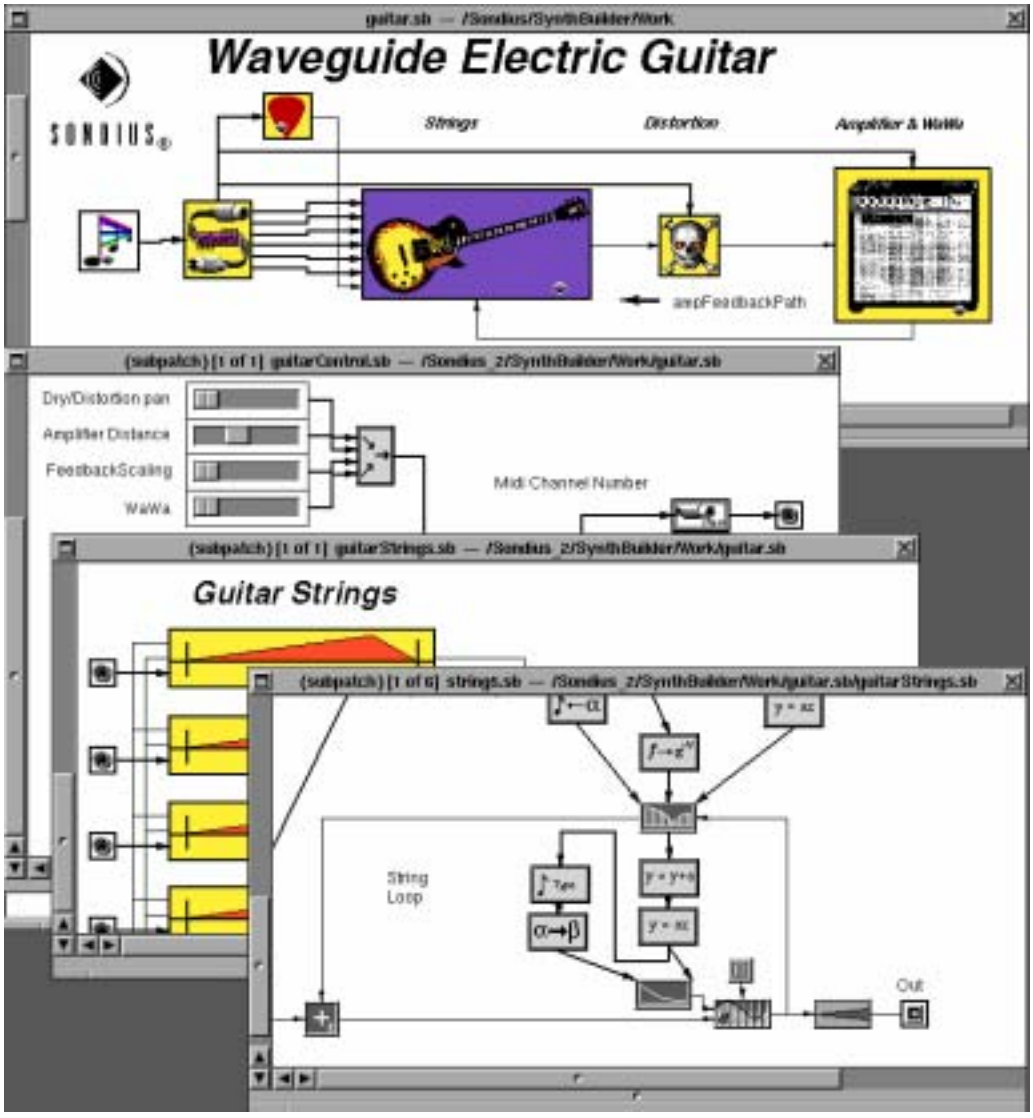


The Frankenstein DSP engine. 8 Motorola EVM's are stacked in 2 columns

SynthBuilder running on a P5 based NeXT machine and the Frankenstein DSP Engine.



A six string electric guitar model with distortion, feedback and wawa, implemented in SynthBuilder. This model runs on on a single 72Mhz Motorola 56002 DSP.