Stanford News

7/9/97

CONTACT: David F. Salisbury, News Service (415) 725-1944;
e-mail: david.salisbury@stanford.edu

Try this at home: Designing virtual musical instruments

A piano you can strum. A flute you can pluck. A violin you can drum.

Such unique musical instruments soon may become reality - virtual reality - thanks to Staccato Systems, a new startup company begun by a group of researchers, based on technology they helped develop at Stanford.

Musically inclined personal computer users will be able to design instruments to their own specification, then "play" them, using either the standard keyboard or a special controller shaped like a musical instrument. An adventurous performer even can don a body glove - a full body suit that translates the body's movements into musical instruction for the virtual instruments.

This latest development in computer sound is based on a new approach to music synthesis known as Sondius® technology. Sondius makes physical modeling of an instrument possible by building a special mathematical model of the actual instrument, rather than simply simulating the sound that it makes. This technique allows considerably more control over musical sounds than previous methods.

The virtual instruments will be interactive, expressive and highly realistic in the sounds they make, the Staccato researchers say.

Performers will be able to control the sounds in ways not possible with current music synthesis programs that run on home computers. For example, performers can:

- control the vibrato or produce overblowing effects on a flute by varying breath pressure;
- change the hardness and strike position of the mallet while pounding on drums, gongs and other percussion instruments;
- morph the very material of a percussion instrument from wood to metal to membrane as they play; and
- create virtual instruments that can't exist physically.

Non-performers will be able to use the software to tinker with recorded performances of professional musicians. A popular current pastime is taking files of such performances that are recorded in the computer-music language MIDI and altering the mix, or balance, among different instruments. With the new software, music aficionados will be able to vary the sound of individual instruments as well.

In addition, Staccato's founders expect that the same technology can be applied to improving the realism of sound-effects in video and computer games and of the sounds exchanged over the Internet.

The key is the Sondius® technology, which was developed at Stanford University's Center for Computer

Research in Music and Acoustics (CCRMA).

Sondius® includes basic patents in several research areas. One of the patented methods is Karplus-Strong synthesis, which produces the sound of instruments like the classical guitar and harpsichord. Another method, called Digital Waveguide Synthesis, models a vibrating string or column of air, and can accurately reproduce the sounds of flutes, reeds and brass. Coupled Mode Synthesis models the sound of things that are hit or banged, like percussion instruments. Additional physical modeling methods duplicate the sounds of pianos and the human voice.

On July 9, Stanford and Yamaha Corp. - a major manufacturer of musical synthesizers and related equipment - announced a joint licensing program, called Sondius-XG™, that combines more than 400 patents and patent applications for the physical modeling synthesis from both organizations. The new program combines Stanford's Sondius® portfolio with similar intellectual property developed by Yamaha and marketed under the Virtual Acoustic® (VA) name. The package also includes patents and applications covering Yamaha's XG format, a set of rules for tone generation that extend MIDI, the standard communication interface among electronic instruments.

Staccato Systems is the first licensee of Sondius-XG™. The company was incorporated in January. In true Silicon Valley tradition, it got its start in a garage in Mountain View, and soon will be moving to commercial quarters. Staccato was formed by Pat Scandalis and Nick Porcaro, who worked on wave guide synthesis as visiting scholars at CCRMA before leaving to form the new company; Scott Van Duyne and Tim Stilson, who are finishing up their doctoral degrees at CCRMA; Julius O. Smith III, an associate research professor of music and inventor of Digital Waveguide Synthesis; and Joe Koepnick, currently on leave from his position as a senior associate in Stanford's Office of Technology Licensing.

The keystone of much of the Sondius® technology is a powerful prototyping tool called SynthBuilder. The software was developed at CCRMA for the NEXTSTEP operating system. Last month, it won the Grand Prize at the Second Annual International Music Software Competition, sponsored by the International Institute for Electroacoustic Music in Bourges, France.

Staccato currently is adapting Synthbuilder to run on Windows and Macintosh personal computers. The software allows users to design their own custom instruments, sound effects and sound processing algorithms. It uses a graphical interface that allows the user to drag and drop icons representing different parts of a virtual instrument around on the screen and to connect them in different ways. An underlying layer of software, called the MusicKit, interfaces with signal processing hardware to convert the graphical representations into synthesized sound. MusicKit was developed by CCRMA and the NeXT Corporation.

A person designing a piano, for example, drags an icon representing a piano string onto the active portion of the screen. Then the designer connects another icon representing the piano hammer to the string. After this is done, the designer can play the virtual piano by clicking on a musical score or playing an attached keyboard. To get fancy, the designer can add icons representing other effects such as reverb, or replace the piano hammer with a violin bow or flute embouchure to create new kinds of virtual instruments. The designer can use the program to create a number of different instruments, enough to assemble a string quartet, dance band or 100-piece orchestra.

More importantly, from a developer's perspective, users can get "inside" the piano string or hammer and design and test new and different synthesis models.

The technology also has the ability to reproduce the sounds of specific instruments. By analyzing the digital recording of an instrument, the waveguide models can be fine-tuned to reproduce its specific acoustic characteristics. This requires a different piece of software that Staccato will make available to software developers. Staccato expects developers to produce models for many different instruments, ranging from famous organs to honky-tonk pianos to old Moog synthesizers.

Physical modeling is not limited to musical instruments. It can be used to create non-musical sounds such as a door slamming or a car crashing into a Dumpster. The sound can be controlled to match the physical characteristics of the objects involved, such as the size of the door, the damping effect of the Dumpster's contents, or the way that the tires skid on the pavement. So Staccato also will pursue the technology's use in video and computer games.

The company will explore potential Internet applications as well, the founders say. The information required to produce a sound using physical modeling is a fraction of that required to produce it using the digitized sound files that are currently in vogue. So a computer equipped with Sondius technology could receive and reproduce sound files much more rapidly, even in real time, if its processor is fast enough.

-30-

By David F. Salisbury

News Home | Help | Current Releases | Search | Guestbook
