Single polymers Physicist Chu discovers value of studying polymer molecules one at a time, page 4

Stanford Report

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Yamaha, Stanford join forces on sound technology

BY DAVID F. SALISBURY

Video games and karaoke may never sound the same.

Stanford's Office of Technology Licensing and the music giant Yamaha Corp. have announced a first-of-a-kind joint licensing agreement on a type of music synthesis that could dramatically improve the quality of computer-generated sound.

The agreement also is a potentially important new revenue source for the university.

At a news briefing held in Tresidder Union on July 9, university and Yamaha officials announced that they are pooling their patents and patent applications on a type of music synthesis called physical modeling. Physical modeling produces sound by generating a mathematical simulation of actual musical instruments, rather than modeling the sounds alone. The approach allows performers to duplicate performance nuances, such as over-blowing or variations in vibrato, that are possible with real instruments. The new licensing program will be known as Sondius-XG.

Musatada Wachi, director of the new program for Yamaha, described it as a "path-making endeavor" for the compa-

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L.A. CICERO

THREE OF THE FOUNDING MEMBERS of startup Staccato Systems – Scott Van Duyne, left, Nick Porcaro and Pat Scandalis – in the Mountain View garage where they began business in January. Staccato is the first licensee of the Sondius-XG program between Stanford and Yamaha Corp. *See story, page 5.*

No price increase for parking permits

For the first time in many years, fall will not bring a rise in parking permit prices. Annual fees for 1997-98 will remain as follows:

A	$310
C or resident	$90
Z	$30
Motorcycle	$25
Service Vehicle	$540

Some things will change, however, says Jeffrey Tumlin of Transportation Programs. All metered parking on campus will double in price to $1 per hour this summer. And new two-year A and C permits will be available at a cost of $620 and $180 respectively.

New permits go on sale Sept. 2, but Transportation Programs will begin

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Successful entrepreneurs talk about how it's done

BY KATHLEEN O'TOOLE

When John Shoch of Palo Alto visited an old friend in Beverly Hills, he discovered they had more in common than Northern and Southern Californians care to admit. His friend took him to breakfast at Il Fornaio; Shoch, a venture capitalist with three Stanford degrees, often starts his day at the chain's Palo Alto restaurant. His friend, in the TV and movie business, proceeded to make an "infrastructure scan" of the tables, taking mental notes of who was eating with whom among the lawyers, writers and agents gathered there.

Amazed at the similarity of the two scenes, Shoch concluded: "This must be a general characteristic of industries."

In the telecommunications age where the world is at your fingertips, how is it that a restaurant – or geography at all – still matters? Nobel economist Kenneth Arrow asked that question at a recent Stanford conference on "the changing nature of entrepreneurship," which drew some of the Silicon Valley's most respected venture capitalists, technologists and scholars.

Hosted by Stanford's Center for Economic Policy Research, the conference was part of a new research effort directed by Stanford economists Paul Romer and Timothy Bresnahan to look at the relationship between national economic growth and the economic well-being of individuals and families.

Geography does *not* matter, AnnaLee Saxenian of the University of California-Berkeley's urban and regional planning department told Arrow, if you are making widgets that haven't changed much in decades. But "in any environment where speed is essential, face-to-face relations still matter," said the author of an authoritative study of the Silicon Valley and Boston's high-tech ghetto, Route 128. The computer industry now centered in the Silicon Valley and Southern California's entertainment industry both operate on an industrial model that is highly networked, rather than hierarchical, she said. "In a networked system, what matters is relationships."

There is more to getting rich in movies or computers, however, than finding the right place to dine. Confer-

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'Useless weed' shows genetic key to flowering plants

BY JANET BASU

The first time Chris Somerville mentioned the plastic potato, it was strictly as a joke. A reporter asked what practical use could come from mapping out the genome of a plant. "Better crops," Somerville replied, and he chose an off-the-wall example. "Maybe we'll grow a plastic potato, to go with the plastic tomatoes we already get in the supermarket."

That was in 1989. Three years later, Somerville's lab borrowed genes from a bacterium and taught a modest weed called *Arabidopsis thaliana* to grow beads of plastic in its seeds. Suddenly it was not such a wild idea to imagine a field of lush green plants growing industrial grade, biodegradable plastic. Monsanto Corp. has assigned a research and development

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Report summer schedule

During the summer, *Stanford Report* publishes every two weeks. The next issue will be July 30. Weekly publication will resume Oct. 1.

Middle School 101: Learning to teach

BY ELAINE RAY

At the Peterson Middle School in Sunnyvale, Donna Kashat makes several attempts to get 22 seventh and eighth graders to quiet down and listen to her instructions. The lesson she is teaching is designed to help students distinguish between speculation and fact, while using their imaginations, their observation skills and their ability to work in groups. But things are not going as smoothly as she planned. Students are engaged in the tasks but are noisy and unresponsive when Kashat tries to get their attention. Neither a review of class conduct rules nor the ejection of a disruptive student seems to help. Kashat, who is being observed by several other teachers, is not only exasperated but embarrassed.

"My class was a bomb!" says Kashat as she dismisses her students then rushes to the canteen to do lunch duty. Doling out sandwiches, chips, candy and various other snacks, she acknowledges that the students ultimately followed through on the assignment, yet she continues to second-guess herself. Kashat, who earned her undergraduate degree in Japanese and Asian studies from the University of Michigan, has taught Japanese and English as a Second Language to high school students and adults for six years. But her first foray into middle school is a real test of her confidence.

Kashat is one of 58 students who are enrolled in the School of Education's Stanford Teacher Education Program (STEP). STEP is a 12-month master's program designed to give graduate students the intellectual and practical experience they need to be effective secondary school teachers.

The Stanford Summer Teaching

See TEACHING, page 8

UC regents' vote on merger delayed

University of California officials have postponed from July 16 to Sept. 18 the meeting of the UC regents' Committee on Health Services, which had been expected to authorize and forward to the full Board of Regents this week the agreements necessary to merge the clinical services of Stanford Health Services and UCSF Medical Center.

The postponement of the committee meeting until the regents' September session "was necessary because all parties to the merger agreed that several issues related to finances and apportionment of liability could not be finalized in time for the committee's consideration," said UC President Richard C. Atkinson and Board of Regents Chair Tirso del Junco in a written statement released July 9.

See story, page 9.

Try this at home: Designing virtual musical instruments

BY DAVID F. SALISBURY

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. *(See story, page 1)*

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

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Yamaha

continued from page 1

ny, which had net sales of $383 billion in 1996. "Sound is an essential part of the multimedia age," he said, noting, for example, the importance of the spine-chilling sounds that herald the appearances of the dinosaurs in the new film *The Lost World*. "Yamaha believes that Sondius-XG can become a de facto worldwide standard," he said.

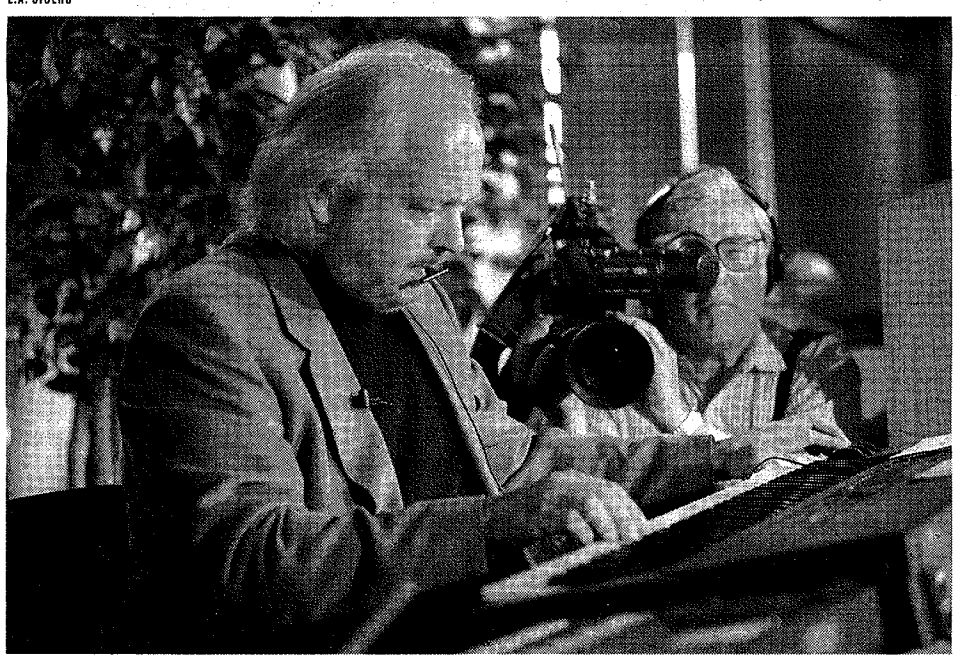
Gary Leuenberg, a professional musician who consults with Yamaha, demonstrated the new technology at the briefing. When he tried the equipment for the first time, he said, "I couldn't put it down. Not only does it sound wonderful, but it behaves like a real acoustical instrument."

In addition to the standard keyboard and foot pedals, the new Yamaha synthesizer came equipped with a headset that includes a flat plastic mouthpiece. By varying how hard he blew on the mouthpiece, Leuenberg was able to alter the characteristics of the synthesized sounds in ways that are not possible with traditional synthesizers.

Physical modeling technology also allows computer musicians to create and play instruments that could never exist in nature, such as a flute played with a violin bow or a 20-foot-long clarinet. The technology also can be applied to reproducing realistic sound effects, like doors slamming and cars screeching around corners.

The joint licensing program, which Office of Technology Licensing (OTL) officials say they believe is the first program of its kind in the country, grants the use of more than 400 patents and patent applications. These include basic patents for physical modeling synthesis developed at Stanford's Center for Computer Research in Music and Acoustics (CCRMA) and previously marketed by Stanford under the name Sondius® and by Yamaha as Virtual Acoustic® (VA). The portfolio also includes patents and applications covering Yamaha's XG format, a set of rules for tone generation that extends MIDI, the standard communication interface among electronic instruments.

L.A. CICERO



MUSICIAN GARY LEUENBERG, who demonstrated the new technology at the campus news conference, said that when he used the equipment for the first time, "I couldn't put it down."

"I'm finally convinced that the computer will eventually take the place of real electronic instruments," said Katharine Ku, director of OTL. "In the future, parents will be asking their children, 'Have you practiced your computer today?'"

In addition to allowing teenagers to practice their music using headphones, rather than disrupting the entire neighborhood, Ku foresees another benefit for parents from the new technology: changing the monotonous sounds of video games. Every time Mario runs into a wall, it won't sound exactly the same. If it's a wooden wall, it will have one sound. If it's stone, it will have another. If Mario hits the wall harder, it will sound different than when he bounces softly. "The sound from video games will be much more lively and real sounding," she said.

The Sondius program was Stanford's first effort to not only patent discoveries made on campus but to trademark them as well. A patent is only granted for a 20-year period. When it expires, the patentholder loses all rights to his invention. Trademarks can be maintained indefinitely and can grow in value as they become well known and associated with quality products. An example is the Dolby Company's trademark on their audio noise reduction process. Electronics companies pay Dolby about $15 million per year to put the Dolby trademark on their products.

"The development of Sondius, started in 1993, was a major experiment for OTL," said Mary K. Watanabe, the OTL associate handling the program. "This major collaboration with Yamaha is a validation of this approach, as well as an important second step."

Under the new agreement, licensees pay a flat fee for the entire portfolio that is less than the maximum fees charged by the previous programs. "This makes things much easier for our licensees. They are not always certain which specific patents they will use in developing new products. With the new program, they will not have to pick and choose,"

'Yamaha believes that Sondius-XG can become a de facto worldwide standard,'

– MUSATADA WACHI OF YAMAHA

Watanabe said.

Stanford and Yamaha have a long-standing business relationship that began in 1975 when Stanford granted Yamaha a license for its Frequency Modulation (FM) synthesis, developed by Stanford professor of music John Chowning. With considerable investment on its part, Yamaha used FM synthesis to develop products such as the world's first fully digital synthesizer and an FM synthesizer chip found on the sound boards that give many personal computers audio capability.

Stanford's FM synthesis patent, which expired two years ago, was the second biggest money maker in campus history. It brought in more than $20 million. OTL officials hope that Sondius-XG will do twice as well, generating more than $40 million in the next 20 years or so.

To Charles Kruger, dean of research, the program is an outstanding example of how industry and universities can work together. Yamaha took the basic research on FM synthesis performed at CCRMA and turned it into real products. Most of the royalties that Yamaha paid to Stanford went to support research and teaching at CCRMA. One result was the advances in physical modeling that form the basis for the new technology and the new agreement, he said.

"This cycle of basic research leading to new products, producing royalties that support new research that lead to product improvements is a win-win situation for everyone," Kruger said. SR

For more information on the web, visit the Sondius-XG web page at http://www.Sondius-XG.com.