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Technology Breakthrough

Physical Modeling Techniques Improve Sound Effects For Games And Animation

Of course, developers of games and other computer-based entertainment software strive to add more realism through the use of 3D graphics. But they also must search for ways to improve sound effects and related audio. One alternative is the use of physically modeled (algorithmically synthesized) sounds, which are said to be more responsive. They also provide better levels of control, realism, expressivity, and flexibility than wavetable or FM synthesis.

The sounds are created on a sound-synthesis engine called SynthCore. It's produced by Staccato System Inc., Mountain View, Calif. This software package, which is an outgrowth of work on the Sondius program done at Stanford University, Stanford, Calif., can be embedded in the entertainment software.

The SynthCore audio rendering engine plays back sounds created by a set of audio development tools ***(see the figure)***.

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Sounds are modeled from the ground up, based on the underlying physics and mathematics of how real sounds are actually created. That's done by physical-modeling software in the development tools. The resulting sounds are more realistic and expressive, making the game more immersive. SynthCore's modular architecture also makes it possible to "mix and match" synthesis methods as is appropriate for the application. So, applications and games can manage system resources very efficiently.

Musical instruments and other game sounds are synthesized from scratch, using audio-signal-processing algorithms. These algorithms are derived directly from the physical equations that describe the behavior of real musical instruments or physical objects. They also are voiced by model-specific sound qualities through a proprietary calibration strategy developed by Staccato. Musicians and game developers make hands-on contact with the important expressive controls.

This gives musical performances and game play a personal, emotionally charged impact well beyond what's possible with wavetable playback.

The algorithms, which can run entirely on the host processor (a 266-MHz Pentium II or comparable host is recommended), can be continually transferred to the engine for execution. That approach is similar to the downloadable-sample approach utilized by most wavetable sound engines. Yet the algorithm scheme used by Staccato employs a lean scripting-style format that makes it easy for game engines to dynamically update sounds and synthesis configurations in real time. Additionally, SynthCore patches can have parameters controlled via a MIDI interface, thus easing the integration with other authoring tools (such as MIDI sequencers) and external control devices.

SynthCore is compatible with the Sondius-XG, XG-Lite, GM, DirectSound, downloadable-sample, and downloadable-algorithm sound schemes. Consequently, developers can use existing sampled-sound libraries and combine them with next-generation synthesis capabilities. By utilizing the downloadable-algorithm capability, developers can craft their own custom signal-processing algorithms in SynthBuilder.

This development tool supports the authoring of a variety of synthesis algorithms, including physical modeling and virtual analog. Algorithms can be graphically designed in SynthBuilder, using generators and note filters to process or generate audio signals. SynthBuilder supports multiple synthesis techniques, including physical modeling, modal, waveguide, FM, additive, subtractive, waveshaping, virtual analog, and vehicle sound.

The SynthBuilder software has a long history. It actually stems from work done in the 1950s at Bell Laboratories on a unit-generator-based, digital audio-synthesis language. The technique was proposed there and updated in the late 1980s and early 1990s by researchers at NeXT Computer, which is now defunct. Work on SynthBuilder has been going on at Stanford University since 1993. Staccato ported the software to Windows 95 in 1997.

In addition to SynthBuilder, development tools include an application programming interface (API) that allows commercial developers to interface their applications to the SynthCore engine. Also available is WavePalette, which is a collection of SynthScript downloadable algorithms that can be substituted for general MIDI-wavetable files. ThunderPalette, a collection of SynthScript downloadable sound-effect algorithms suited for game applications, is available as well.

For more information, contact Bob Starr at (650) 254-1971. Or, check out *http://www.staccatosys.com*.

Dave Bursky

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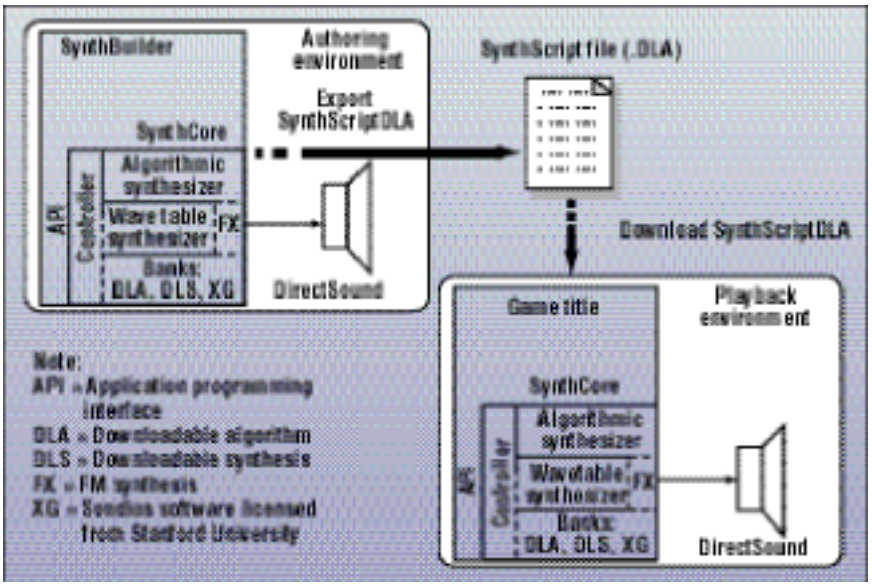

SynthScript downloadable algorithms, which represent custom sounds, can be created using the SynthBuilder authoring environment. The algorithms are then incorporated in the target application. When that application is run on the host system, the SynthCore sound-synthesis engine will create the sounds, which are modeled after the underlying physics of the sound.

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