XAVIER SERRA

SmsTools (Win)

Mix, match, and morph your audio files.

By Dennis Miller

Most desktop musicians are familiar with common synthesis methods, such as additive, subtractive, and FM, but less well-known is the powerful technique called analysis/resynthesis. With this method, you break a sound file into its component parts, use specialized tools to alter those components, and then "reconstitute" the sound using the transformed data. *SmsTools,* from Xavier Serra and the Music Technology Group of the Audiovisual Institute of the Pompeu Fabra University of Barcelona, is a free PC program. It offers a new approach to resynthesis that enhances the techniques provided by other applications. (There are several Macintosh programs based on this method; see the sidebar "Mac Options.")

SmsTools is a graphic interface to the powerful Spectral Modeling System created by Serra and his colleagues. (A nongraphic version that offers a number of enhancements, including support for the IRIX and Linux systems, is also available.) The program analyzes standard WAV files and separates the stable, pitched components from the noise elements of the sound. It then creates an analysis file for both types of information and allows you to manipulate the analysis data before resynthesizing the sound. For example, you can isolate the noise portion of a flute sound or the non-pitched elements of a vocal sample and apply various types of processing to each. The results can be fascinating.

GETTING FRAMED

As with other synthesis programs, *smsTools* breaks your sound file into

smsTools
Minimum System Requirements
Pentium 75; 16 MB RAM; Windows 95/98

For manufacturer information, please see Contact Sheet, p. 195.

small chunks called "frames" and detects the amplitude peaks in the spectrum of each frame. These peaks represent the harmonic partials of the sound, and by tracking the peaks from frame to frame, the program can determine the individual amplitude envelopes for each partial it detects (see **Fig. 1**). By using additive synthesis to generate a large number of sine waves under the control of these envelopes, you could, in theory, accurately resynthesize any sound that you've analyzed. Of course, the point is not simply to create a replica of the original sound, but to modify the envelopes before performing the resynthesis. *SmsTools* offers many functions for this purpose.

In addition to detecting the stable partials, *smsTools* also keeps track of the additional noise components of the sound, which it calls the *residual*. The residual typically includes elements such as the key clicks of a wind instrument or the bow noise of a string instrument. Even the human voice contains both pitched and noise components. Using filtered white noise, *smsTools* can resynthesize the residual data as well, and, as expected, you can apply many transformations to this material before you resynthesize it. I isolated and resynthesized just the residual of my voice, and the result had a sort of scratchy, grainy quality that reminded me of Marlon Brando's Don Corleone character in *The Godfather*. You can hear the results at

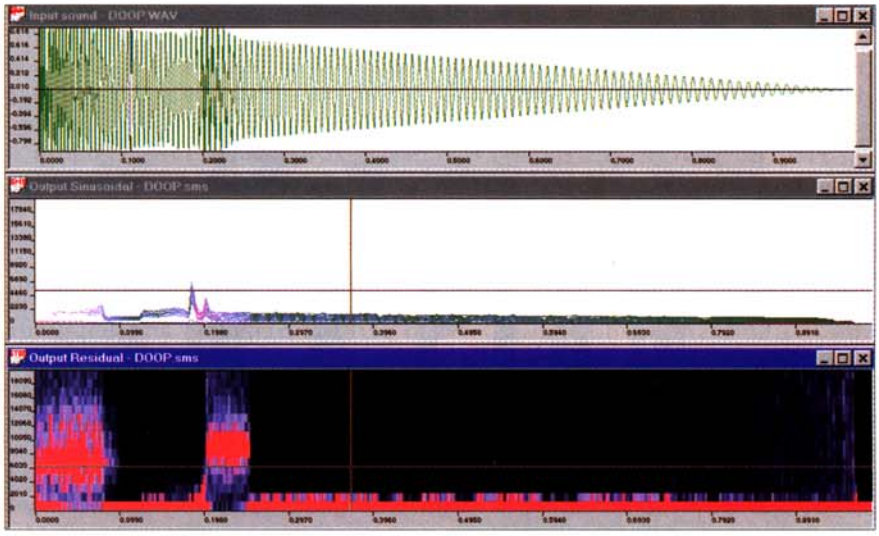

FIG. 1: *SmsTools* can analyze any Windows sound file and allows you to manipulate the analysis data before resynthesis. Here are the original WAV file (top), the sinusoidal analysis (middle), and the residual, or "noise," portion of the sound (bottom).

MAC OPTIONS

Macintosh has long been the platform of choice for advanced sound synthesis, and it's no surprise that several Mac programs offer tools for exploring the spectral components of a sound. (You'll find a number of Mac analysis/resynthesis programs, including the two mentioned here, at shoko.calarts.edu/~tre/compmusmac/.)

Among these are Tom Erbe's *Sound Hack* ($50 shareware registration) and *Lemur*, written by Kelly Fitz and his colleagues at the University of Illinois. *Sound Hack* will read and write numerous types of files, including AIFF, SDII, and WAV, and offers extensive options for configuring your analysis. Once your sound is analyzed, there are numerous alterations that you can make, such as spectral dynamics processing, phase vocoder–based time stretching and pitch shifting, and crossing the spectra of two different files (convolution). The program has excellent documentation and produces high-quality results.

Lemur (free) also provides numerous configuration and processing options, but its main functions are high-quality time stretching and pitch shifting. The program shows a "sound print" as it performs its analysis (see **Fig. A**) and can also create data files that can be used by "third-party" applications. For example, the program's analysis files can be manipulated in real time by the Kyma System from Symbolic Sound.

Speaking of the Kyma System, sound designers on either Mac or PC who are looking for total immersion should explore this hardware-accelerated synthesis workstation. (For a review of Kyma, see the January 1998 **EM**.) Kyma has the most powerful, real-time analysis/resynthesis features I've ever seen and can perform such mind-boggling feats as time-stretching live audio input as it comes into the system. If resynthesis is on your mind, you'll definitely want to look into the Kyma System sound-design workstation, available from Symbolic Sound.

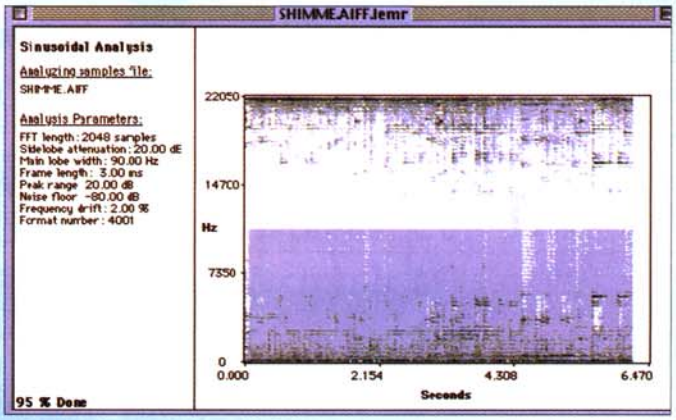

FIG. A: *Lemur* displays a sound print as it analyzes a sound file. The actual processing is done using drop-down menus.

EM's Web site, www.emusician.com.

SmsTools offers a well-integrated, graphic interface and works equally well with periodic (pitched) and nonperiodic (unpitched) source material. The Help file provides tips on how to get a good analysis, and the program includes numerous options for accomplishing that goal. (You should also check out an excellent primer on analysis/resynthesis, written by Serra, at www.iua.upf.es/~sms/docs/msm.)

First, it recommends that you use a clean, unprocessed sample that is normalized to maximum amplitude. Next, you can improve the analysis by telling the program whether your source is pitched or unpitched, and if it is pitched, what the sound's fundamental frequency is. You can specify how large a frame size *smsTools* should use (smaller is better) and also determine what the threshold for detecting a peak will be.

TWEAKS

Once you have a good analysis file, the fun really begins. There are numerous ways to transform the analysis data, including amplitude and frequency-based modifications, Modulation, time stretching, and Hybridization. The amplitude modifications include scaling the amplitude of the entire sound, just the odd or even partials, or even single partials. Using a 2-dimensional grid, you specify how much the scaling factor will affect any range of partials throughout the duration of the sound (see **Fig. 2**).

Similar transformations are possible for the frequencies of the partials. For example, you can scale all or any of the partials, or stretch the partials so they move progressively away from the fundamental. Applying a stretch value of 2, for example, would shift all frequencies upward so that the highest frequency would end up at double its original value.

The Modulation feature allows you to perform frequency and amplitude modulation on both the partials and the residual. Low modulation rates will produce vibrato effects, and higher values will generate sidebands, as with FM.

Finally, the program's Hybridization option allows you to morph or "clone" components from different sounds. This feature is particularly effective on sounds that have stable harmonic partials (i.e., most pitched sounds), but it can also produce interesting results using unpitched source material. You can control how the morph will occur over time, what section of each file to use, and most importantly, how much of each sound's frequency and amplitude composition will be used.

For example, you could use just the amplitude envelopes of sound A and apply them to the frequencies of sound B, or you could use 50 percent of each. There is an endless number of combinations for you to try out, and the range of sounds you can produce is enormous.

EVEN MORE TOOLS

Time stretching is a popular technique in audio software these days, but it is also notoriously difficult to get good results with this. That's why many programs limit stretching to a maximum of two or three times the length of your original file. *SmsTools* allows you to stretch your sound as much as you want and also lets you create a graph that will vary the amount of stretching over time. The results are just about the best I've heard.

Using the time-stretch feature, you'll hear things in your sounds that you've never encountered before. For example, I stretched a saxophone note to twenty times its original length, and the pitch fluctuations in the attack segment of the note were absolutely incredible. Other long stretches produced similarly interesting effects, and noticeably lacking were the artifacts that are normally produced with this type of processing.

CHECK IT OUT!

Overall, *smsTools* offers a very powerful tool kit that enables you to modify sounds in ways that you won't find on even the most expensive sampler. It would be easy to go on and on about its numerous settings, helpful shortcuts, excellent documentation, and the high quality of its processing routines. But for this price (it's *downloadable freeware,* remember!), there's no reason not to check it out for yourself. It's a great device for creating startling new sounds.

EM *Associate Editor* **Dennis Miller** *lives in the suburbs of Boston.*

XAVIER SERRA
smsTools resynthesis software
freeware

FEATURES ■■■■■
EASE OF USE ■■■■
QUALITY OF SOUND ■■■■■
VALUE ■■■■■
1 2 3 4 5

PROS: Powerful resynthesis features. Intuitive graphic interface. Free of charge.
CONS: Advanced features can be overwhelming.

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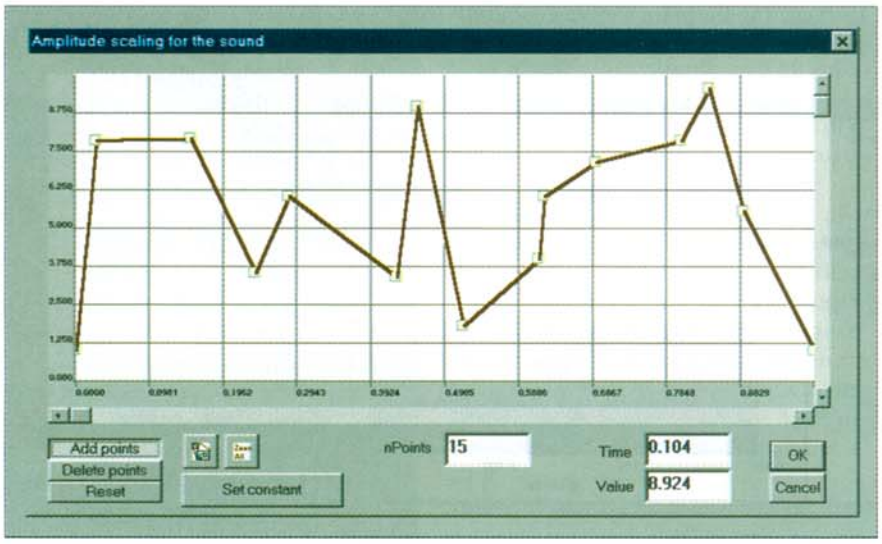

FIG. 2: Graphic envelopes can be created by the user to determine how a sound will be transformed before it is resynthesized.