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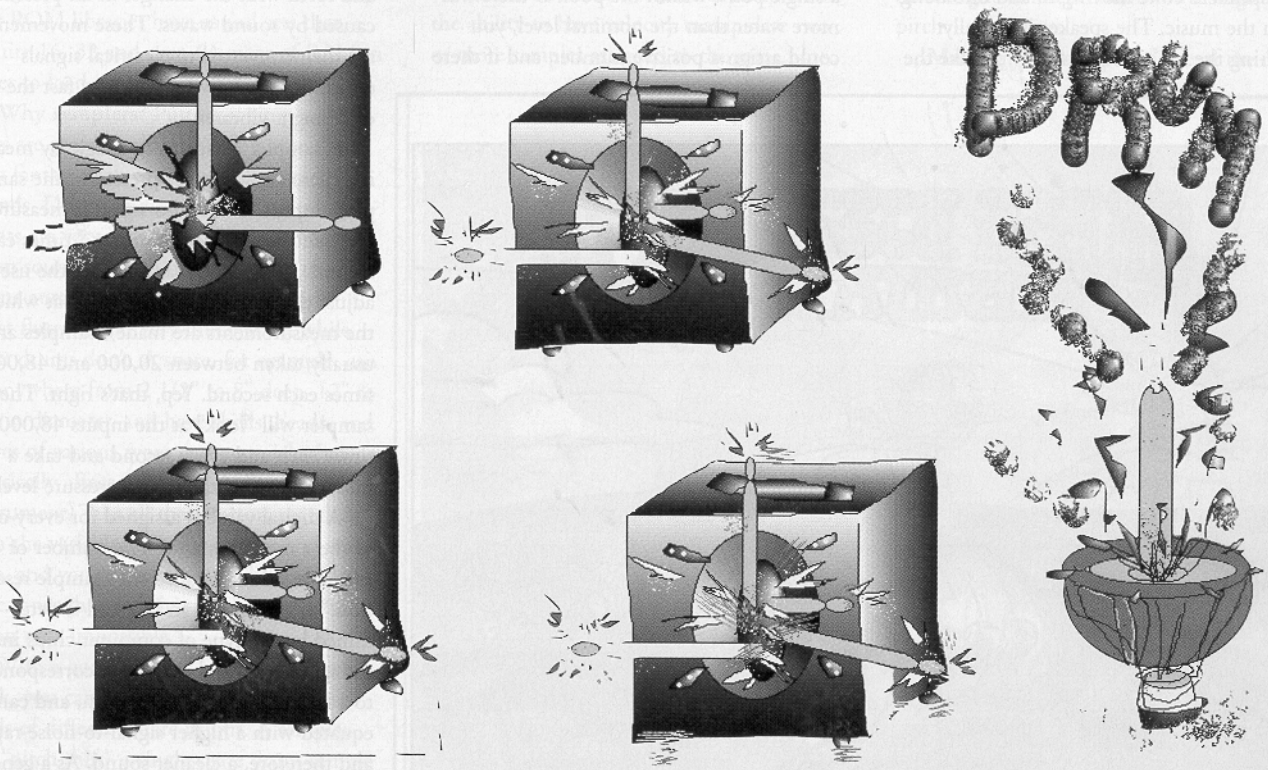

Return to Sampler Land

SAMPLING BASICS

by Norman Weinberg

We sometimes forget that new drummers come into the fold every day. Got the handle on paradiddles, drop triplets, or drum programming with a computer-based sequencer? Well, there are certainly good young players who don't know the ins and outs of these topics. In addition, when it comes to electronic percussion topics, there are those players who, for one reason or another, were slow to adopt these instruments. Even players who have a pretty good idea of how to incorporate electronic percussion into their careers often enjoy getting more background, details and information that may fill in some holes. So let's start at the beginning with samplers.

What is a sampler? A sampler is a type of sound module that creates and manipulates samples. A "sample" refers to a digital recording of a sound. The term comes from the fact that "samples" of an audio waveform are taken several thousand times per second. These individual samples, when taken together and played back in the same order they were recorded, serve as a type of digital photograph of the original sound. Other sound modules called "sample playback synths" create sounds by playing back samples, but they're not able to make their own original samples.

A sampler can make any sound imaginable. It can duplicate acoustic instruments, such as percussion or woodwinds. It can also reproduce natural sounds from the environment like rain and thunder. Samplers can even take familiar sounds and alter them to such an extent that the end result is something that has never been heard before.

How do samplers work? To understand how samplers work, it's important to understand just what sound is. Sound is nothing more than a movement of waves through the air. If you throw a stone into a small pool of water, you can easily see the waves or ripples that are created. The amount of the water in the pool hasn't changed at all, but as the ripples expand outward, there are places in the pool that contain more water than others. Therefore, as you look across the top of the water, those

Illustration: Scot Halpin

spots can be said to have a higher water level.

When a sound is created, these same types of ripples are sent out through the air. If you inspect a loudspeaker, it's easy to see the speaker's cone moving in and out along with the music. The speaker is actually pushing the air back and forth just like the wave machine at a water park.

If you can see these waves, then there must be some sort of way to measure them and assign them numbers. There is! One way would be to determine the level of the water when the pool was absolutely still, and then take measurements of the amount of water at any particular instant in time at a single point within the pool. If there was more water than the nominal level, you could assign a positive number, and if there was less water, you could assign a negative number. If you can make this type of measurement with water level, you can make the same type of measurement with sound pressure levels.

By the way, this is exactly how a microphone operates. The small, sensitive diaphragm inside a microphone moves back and forth with the changes in air pressure caused by sound waves. These movements are then converted to electrical signals depending on how far and how fast the diaphragm vibrates.

A sampler performs its magic by measuring these audio signals present at the sampler's inputs. The audio signal is measured (or "sampled") several thousand times each second. While most samplers let the user adjust the sample rate (the speed at which the measurements are made), samples are usually taken between 20,000 and 48,000 times each second. Yep, that's right. The sampler will "look" at the inputs 48,000 times each and every second and take a measurement of the sound pressure level.

A digital value is assigned for every one of these measurements. The number of available values is called the "sample resolution." It's measured in bits and is determined by the type of computer chips inside the sampler. A higher bit rate corresponds to a higher sampling resolution, and can be equated with a higher signal-to-noise ratio and therefore, a cleaner sound. As a general guideline, each additional bit of resolution will add 6 db to the S/N ratio. Most samplers today are 16-bit machines and can assign one of 65,536 different values. With this much precision, samplers have a very clean sound. Samples that are made with a 16-bit machine at a sample rate of 44,100 will have as much dynamic range and musical accuracy as a compact disk.

Now what? Once a sound has been sampled, it needs to be stored. A sampler's internal memory is volatile, and if the machine is turned off before the sample is saved, your great sample will be lost forever. For long-term storage, samples can be stored on an internal or external hard disk or some type of removable media such as a Zip disk, optical disk or CD-ROM.

When it's time to play the samples, they need to be loaded into the machine's RAM (random access memory). More is always better when dealing with RAM. If your sampler came with only 2 megs of RAM installed, you should note the amount of

maximum RAM the sampler will handle. Now that the prices of RAM chips have fallen pretty low, it's a good idea to buy as much RAM memory as you can afford.

A general rule of thumb is that each minute of stereo sampling time takes about 10 Megs of RAM. In the early days of samplers, it was common to find machines with a megabyte or less of memory. Today, some CD-ROM libraries have sound sets that require 16, 32 and even 64 megs of RAM in order to load properly.

Why samplers? Putting it simply, samplers are great for drummers because they do a fantastic job of reproducing drum sounds. Drums and other percussion instruments are very individual. A good snare drum sound is much more difficult to define aurally than a good flute sound. Most flutes sound very much alike, while most drums don't. A snare, for example, can be anywhere from 2 1/2" to 8" deep, 12" to 16" in diameter, and have shells, heads, and snares of various types and materials that drastically affect the tonal quality of the instrument. Take all these factors together with the variables of tuning range and stick type, and you've got so many different possible tones that defining "the" snare drum is damn near impossible.

With a good sampler and a little careful work, you can own the equivalent of hundreds of different snare drums. A sampler can "pitch shift" a single snare drum sample to create four to ten different instruments. You can sample the same snare with the heads cranked way up or down pretty loose. You can also add a little muffling or a tone ring to the batter head. Sample the drum when using small jazz sticks or heavy rock sticks. Be creative and just think of all the different sounds one single instrument can produce. Each of these unique sounds can be put to good use without losing the realism of a natural snare sound. Sometimes, even losing the natural sound can be very cool!

Once the sample has been made and the sound has been digitized, the sampler's computer power can be put to work. Using the features of the sampler, you can add special effects or transform the sound in a number of different ways. You can also route certain performance commands, such as the playing velocity, to performance characteristics. For example, you might want to route playing velocity to the position of the sample in the stereo field. Or, you could route velocity to the cutoff filter frequency so that stronger playing levels make the sound brighter. Depending on the features of your individual sampler, you may be able to reverse sounds, pitch shift samples, perform time compression and expansion algorithms, transform, multiply, resample and add digital audio effects like reverb or chorus.

Another common feature of samplers is the ability to have velocity manipulate two or more samples assigned to the same note. For example, if a ride cymbal and a crash are both assigned to the same note, you can tell the sampler to trigger the samples depending on your playing velocity — play softly and you'll hear the sound of the ride, play louder and the crash cymbal sample will kick in. Depending on the machine, you may be able to switch, blend or stack up to eight different sounds on a single pitch.

Making your samples. One of the most

MAKING MULTI-SAMPLES

With samplers, drummers are no longer limited to only playing drum sounds. In *CrossTalk*, the electronic percussion ensemble at the University of Arizona, we use samplers to fire plenty of drum sounds, but we also use them for playing bass lines, keyboard parts, background pads, lead guitar or synth solos, and just about any other sonic color we need. To create realistic instruments we often multi-sample.

Multi-samples are groups of samples that are used to replicate the wide musical range of musical instruments. Taking a single sample and stretching it over the entire range loses the subtle timbral changes that often take place from pitch to pitch. Creating a sample of each and every tone uses a lot of memory. In the example below, two samples are taken for each octave. Using this format, a small number of samples can cover a large range, and no sample has to be stretched more than three half steps.

SAMPLED NOTE	LOWEST KEY	HIGHEST KEY
C1	A0	Eb1
F#1	E1	Ab1
C2	A1	Eb2
F#2	E2	Ab2
C3	A2	Eb3
F#3	E3	Ab3
C4	A3	Eb4
F#4	E4	Ab4
C5	A4	Eb5
F#5	E5	Ab5
C6	A5	Eb6

In the next example, taking four samples per octave insures that no sample will be stretched more than a half step.

SAMPLED NOTE	LOWEST KEY	HIGHEST KEY
C1	B0	C#1
D#1	D1	E1
F#1	F1	G1
A1	G#1	A#1
C2	B1	C#2
D#2	D2	E2
F#2	F2	G2
A2	G#2	A#2
C3	B2	C#3
D#3	D3	E3
F#3	F3	G3
A3	G#3	A#3
C4	B3	C#4
D#4	D4	E4
F#4	F4	G4
A4	G#4	A#4
C5	B4	C#5
D#5	D5	E5
F#5	F5	G5
A5	G#5	A#5
C6	B5	C#6

putting some tape on that window that rattles every time you play your kick drum.

Set your sampler up to make the recording. Here are some of the items you may have to adjust:

• Sample rate. This is the speed at which the sampler "watches" the input and assigns one of the values. Higher sample rates mean better frequency response, but will use up more RAM.

• Sample length. Before sampling, you can tell your sampler how many seconds you want the machine to record. Always set a sample length that is slightly longer than you'll need.

• Recording level. To get the best possible sample, you always want to record at the highest possible level without clipping. This will insure that your sample has a great "signal-to-noise ratio" that is free of distortion caused by a "too-hot" recording level.

Once you've captured your sample, you'll want to "truncate" it. Truncation removes any unwanted space at the beginning and end of your sample to make memory usage more efficient. You'll also need to place your sample within a certain range of MIDI note numbers. One common method is to first specify which note will be the location of the original sample, a note that will serve as the lowest note and another note that will serve as the highest note. If the sample is made to cover a number of notes, the sampler will "pitch shift" over the keys. (See page 104 for more on multi-sampling).

Remember, new sounds can be found just about anywhere! Tin cans, table tops, structural walls, the bottom of a plastic cup or even two Frisbees struck can be sampled and played as percussion. Think about sampling a can of spray paint, drop the pitch down about an octave, reverse it, and truncate its length to about a half second. The result? A very mean gated snare!

Using sample libraries. In addition to making your own samples from scratch, there are other ways to get new sounds into your sampler. There is a small cottage industry that caters to sampler owners. They produce and publish both audio compact disks specifically designed for sampling and CD-ROMs.

To make new samples from an audio CD, just load the disk in your home CD player or even on a portable one, plug the player's audio outputs into your sampler's inputs and start sampling. The main advantage of sampling CD libraries are that they tend to be a fraction of the price of comparable CD-ROM disks. The downside is that you'll have to tweak each sample yourself.

To grab samples from a CD-ROM library, you'll need to have a sampler with an internal CD-ROM drive, or a sampler with an external CD-ROM player. It's also important that the CD-ROM library that you purchase be compatible with the brand and model of your machine. Similar to some computer platforms, if you buy a CD-ROM intended for brand A, it may not load properly into a brand B sampler.

While CD-ROM libraries are a little

pricey, good ones are optimized for your sampler. Sounds will be assigned to their proper locations, cross-fades will already be programmed, and all features and control parameters may have already been adjusted to ease of use and maximum playability.

Remember that samples don't have to be a single note. A sample can be a lick, a groove, a snippet of text, or depending on the amount of memory you have installed, a complete digital recording of an entire song.

Loops. Here's one of the most innovative and influential uses. In a nutshell, you sample a beat, measure or phrase from another recording, loop it, and use it as the basic building block for an original composition. You can also take several different loops and layer them together to create entirely new textures.

The most common type of loop is called a forward loop. When using a forward loop, samples play from their beginning to the specified loop stop point. Then the sampler will quickly jump back to the loop start position and re-play the data. This loop continues until the sampler receives a message to turn the note off. This is the type of loop to use when you want a two-bar groove to repeat over and over.

Another creative force is the forward/backward loop. Samples using this style will play through to the sample stop point, reverse, play the data backwards to the sample start point, then reverse again. Sound cool? It can be!

Loops can be a good practice tool as well as a good compositional or DJ tool. Grab a cool bossa or a shuffle groove. Loop it and practice playing over the top. This is a wonderful way to improve your concentration, sense of time, style and soloing chops.

As you can see, samplers are plenty powerful and serve the digital drummer well. There has never been a better time to get into samplers. For the last several years, the power, flexibility and ease of use have increased while the price has fallen. Even sample libraries — both audio and CD-ROM — have seen a huge expansion in available sound sets, as prices have remained steady or decreased. If you're looking for a way to expand your sonic state, samplers are the way to go! ■

FIGURE ONE

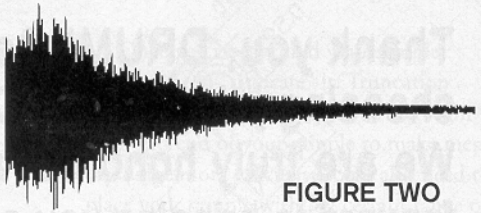

FIGURE TWO

Visual Representation of Sounds

These two illustrations show the waveforms of different cymbal samples. Fig. 1 shows the sound of a crash cymbal played with a stick on the bow. Fig. 2 is the same instrument played near the edge with a soft mallet. The timeline of the sound runs left to right (both samples are four seconds long), and the relative amplitude can be seen by the vertical height.

It's easy to see that the sample with the stick on the bow has a lower volume than the stroke with the mallet. Notice also that the stick stroke begins strong and immediately starts to fade out, while the stroke with the mallet grows a little before reaching its maximum amplitude and fades more slowly.