THE ESSENTIAL GUIDE TO...

NEXT MONTH
VOCODING
computer music

Subtractive synthesis

Mac PC

It's by far the most popular method of synthesis there is, but what exactly is it all about?

On the DVD

VIDEO TUTORIAL
We've put together a video to accompany the walkthrough. It's in the **Video** folder

JARGON BUSTER

▸ OSCILLATOR
Produces a basic waveform of a given type (eg, sine, sawtooth, square, etc)

▸ LP FILTER
A low-pass filter attenuates all frequencies above its cutoff frequency

▸ HP FILTER
A high-pass filter attenuates frequencies below its cutoff frequency

▸ BP FILTER
A band-pass filter attenuates all frequencies except those surrounding its centre frequency

▸ LFO
Low Frequency Oscillator. Used to automatically control certain synth parameters so that they change over time in a repetitive way

▸ ENVELOPE
Another control signal that can be used to change the way a sound responds to note-on and note-off events

▸ ADSR
Attack, Decay, Sustain and Release – the four time-based stages of a standard envelope

We've focused on a number of different effects in our *Essential Guide* series so far. This month, however, we're looking at how sounds can be created from scratch – in other words, synthesis. Many musicians shy away from the idea of creating their own sounds and synth patches, preferring to make use of factory presets or patches created by others. Others, however, enjoy the satisfaction and artistic purity that comes from starting from scratch.

Over the course of the next few issues, we'll be looking at various different sound generation techniques and synthesizer technologies. We're going to kick things off by looking at the most ubiquitous artificial sound creation method of all: subtractive synthesis. A huge number of synths (both hard and soft) produced over the past four decades have been subtractive.

So what makes subtractive synthesis such a popular choice? The answer lies, in part at least, in the simplicity of the technique. You start with a waveform and then filter out harmonics or bands of harmonics to produce a range of different sounds and tonal colours. The good news is that this simplicity translates into very easy learning curve for the user.

Here we'll educate you as to what subtractive synthesis actually is, what it's used for and how you can make it work for you. We'll give you some practical applications and finish things off with a brief tutorial. **cm**

AMPLITUDE ENVELOPE
These sliders control how the volume of the sound changes over time. This is a standard Attack (time), Decay (time), Sustain (level) and Release (time) configuration

FILTER ENVELOPE
Similar to the amplitude envelope, but used to control the cutoff frequency of the filter

OSCILLATOR
Despite the fact that it only has two oscillators, CM-101 can produce a surprising range of different sounds. The secret is knowing how to create them!

OSCILLATOR WAVEFORM
CM-101 offers four different wave shapes: sawtooth, square, triangle and sine. These all have very different sounds

LFO
The LFO doesn't create any sound itself, but is used to control other parameters. Different wave shapes can be used and its speed can also be changed

FILTER CUTOFF AND RESONANCE
These define the characteristics of the filter – the frequency at which the filter starts attenuating signals and the amount of boost that's applied around the cutoff frequency

WHAT IS IT?

As we've already mentioned, subtractive synthesis starts with a raw waveform. Most basic subtractive synths can produce square, triangle and sine waves, while more advanced models also have sawtooths, square waves with different pulse widths, and other more exotic options. A pure sine wave contains just one frequency (the 'fundamental'), whereas a square wave contains the fundamental and all odd harmonics, giving a hollow, wind instrument-like sound. A sawtooth wave contains both odd and even harmonics, giving a thicker, string-like sound.

Many subtractive synths have more than one oscillator, allowing different waveforms to be mixed together, or similar waveforms to be de-tuned against each other, thickening the sound.

Once the basic tone has been produced, it's normally filtered by a low-pass filter. This lets lower frequencies through, while attenuating higher frequency components beyond the filter's cutoff frequency. A low-pass filter dulls the overall sound. Some subtractive synths also have band-pass and high-pass filters, which give 'thin' and 'crisp' sounds respectively.

Almost all subtractive synths feature some kind of modulation capabilities in the shape of control signals that can be used to change various characteristics of a sound over time.

WHAT'S IT USED FOR?

Despite being based on a relatively simple synthesis technique, subtractive synths can be extremely versatile and are used to produce everything from lead sounds and basses to pads and strings. Many subtractive synths can even be used to produce electronic drum sounds or off-the-wall sound effects. In fact, many dedicated electronic drum machines are essentially specialised subtractive synths.

While some models (such as Novation's BassStation) are designed to fulfil a specific niche, others are intended to be more general workhorse units. Novation's V-Station is a good example of such a synth. Generally speaking, these general purpose synths tend to be more flexible in terms of the internal signal routing and modulation options on offer. Unfortunately, the additional flexibility tends to quickly add complexity, though, and a lot of extra controls that can confuse and bewilder a beginner.

▼ **Subtractive synths such as the Novation Super BassStation were popular with dance pioneers like Orbital**

HOW DO I USE IT?

The process of creating a sound from scratch in a subtractive synth can be quite drawn out. Whether you're trying to reproduce a synth sound you've heard elsewhere or emulate the sound of a real instrument, the steps you have to follow are essentially the same.

You need to begin by listening to the basic tone and then decide on a waveform to start with. If the target sound has a hollow quality about it, for example, start with a square wave. Over time, you'll learn to associate certain types of sounds with particular raw waveforms.

Next, try to listen to how the sound changes over time. Does it start and end abruptly or gradually, for example? If so, adjust the amplitude envelope attack and release values accordingly. Listen out for changes in the characteristic of the sound which may give clues about how the filters are being used.

If a sound changes in a repetitive way, then think about how you can reproduce this using LFOs to modify the oscillator behaviour or control the filters.

Bear in mind that becoming a skilled subtractive synth programmer takes time and patience. A good way to start is by unpicking some of the patches that come with your favourite soft synths.

FIVE TO TRY...

Triangle II
www.rgcaudio.com

Alpha Classic
www.linplug.com

Pentagon I
www.rgcaudio.com

Discovery
www.discodsp.com

V-Station
www.novationmusic.com

STEP BY STEP Creating a classic lead with CM-101

1 Install CM-101 from the cover DVD and load it up in your VST host. Click on the triangle wave button of Oscillator 2 (as shown), then locate the oscillator **Detune** controls. Set the first to **-4%** and the second to **+4%** to thicken the sound. »

2 Play a few notes. You should hear a bright but boring tone. Reduce the filter **Cutoff** setting to about **80%** to dull the sound slightly. Increase the filter **Resonance** setting to about **30%** to add a little character. »

3 At the moment our patch sounds very static. Increase the amplitude envelope **Attack** setting slightly to take the hard edge off the start of each note. Increase the **Decay** time to **300ms** and reduce the **Sustain** level to **70%**. Finally, increase the **Release** time to **600ms**.