

TEN MINUTE MASTER No17: Vocoders

The vocoder is one of the most enduring audio processing effects of all time. **Ian Waugh** explains how to make it sing. And talk, and dance, and mutter, and play the drums...

Although the human voice is the most versatile and expressive of instruments, in true creative style musicians still like to change and modify it. A vocal that sounds in some way different to other vocals will stand out and attract attention to a recording.

One of the first commercial recordings to feature voice processing was *Sparky's Magic Piano* released by Capitol in 1947. This landmark children's story is still available today. It used a device called a Sonovox, which was mechanical in nature and worked by pressing two small disks to the performer's throat. Although it was not a vocoder and it worked in an entirely different way, the results were similar and many people assume the result was achieved with a vocoder.

The vocoder comes of age

The vocoder was developed in the 1930s by an employee of Bell Labs called Homer Dudley. Its original purpose was to improve speech transmission over telephone lines, essentially by reducing content to enable more data to be sent over the line's limited bandwidth. It was, in fact, also used during World War II to scramble telephone conversations between Franklin D Roosevelt and Winston Churchill.

The vocoder has been used in all forms of music – it was particularly prevalent in the pop and disco genres of the 70s – and regularly drops in and out of fashion. Memorable songs featuring a vocoder include Kraftwerk's *We Are The Robots*, Laurie Anderson's *O Superman* and ELO's *Mr Blue Sky*. The 1998 release of Cher's *Believe* heralded a new era of vocoder-processed tracks, the most renowned and recent of which being Madonna's *American Life*.

Initially, vocoders were only available as hardware devices. Some models from the early 1980s, such as the Korg VC-10 and Roland's VP-330 and SVC-350, were much in

demand on the second-hand market when the analogue retro scene arrived in the 1990s, and some are still in use today. Modern hardware vocoders are still available (the Doepfer vocoder synth modules, for example) but the recent trend has been towards software plug-ins, which are often more versatile and, of course, much cheaper.

What's in a name?

It's not absolutely essential that you know exactly how a vocoder does its stuff in order to use one, but if you do know what's going on under the hood, you might find yourself using it in novel and unique ways.

The name vocoder is derived either from VOICE CODER, VOICE enCODER or Voice Operated reCOrDER, depending on which source you read. A vocoder has two inputs called a carrier and a modulator, and if you're familiar with carrier and modulator terminology from FM synthesis you'll be way ahead of us. As the names suggest, the modulator modulates the carrier signal. In a vocoder, the modulator is usually a voice and the carrier is the signal that the modulation is imposed upon – usually a pad-type sound. This produces the typical 'talking synth' or 'robot voice' effect typically associated with vocoders.

Here's the techy explanation. A vocoder analyses the voice and splits it up into frequency bands, much like a spectral analyser. It might have six, eight, ten, twelve or more bands. Filters are also used to split the carrier signal into the same number of bands, each of which is controlled by a VCA (essentially it controls the volume of the frequency band in the carrier signal).

Let's assume you say something at a low pitch. This will be analysed into the lower bands, which in turn activate the lower-band VCAs, which will then pass the corresponding frequencies in the carrier signal. So when you talk, the analytical filters output energy levels corresponding to the frequencies in your voice



Although now showing its age to some extent, Prosoniq's Orange Vocoder plug-in is still one of the most popular software vocoder effects.

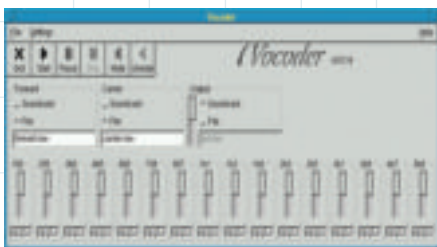
with the result that the energy patterns of your voice are superimposed on the carrier.

It's not quite what you think

Note that it's the voice characteristics that are imposed upon the carrier, not the voice pitch, so to make your voice 'sing' you talk into the vocoder and generate the required notes by changing the pitch of the carrier, perhaps by playing a keyboard. When using a software vocoder, you'll probably pre-record the pitches you need for the carrier and then apply the vocal modulator to these.

The best carriers are those that are harmonically rich – so pads, strings and brass are good starting points. The carrier should contain the frequencies that are present in the vocal range being used. Our full vocal range runs from around 80Hz to 1kHz, although the range used in normal speech will be much less. The frequency range will also be different for men, women and children. Note also that both sources are usually required in order to produce an output. If you stop talking or stop playing, the vocoder output will stop, too.

The power of software has meant that vocoders don't have to follow the format of



Software vocoders are even available for Linux. This one, simply called Vocoder, runs under LADSPA.



Doepfer vocoder modules (top) with other synth modules (bottom) you might use to control them.



Most modern sequencing software includes vocoding functionality. This is Cubase VST's vocoder plug-in.

their hardware predecessors and many feature far more controls. These may include an adjustable number of frequency bands (the more bands there are, the higher the definition of the audio), adjustable bandwidth (narrow bands will produce a thinner sound), filter and resonance controls, envelope settings (which determine how quickly the modulator triggers the carrier) and more besides.

The trouble with fricatives

Fricatives are high-pitched sounds, such as S, T, K, F and P produced by the mouth rather than the vocal tract, and they often don't reproduce well on a vocoder. Some devices, therefore, add noise to duplicate the sound, while others use a low-pass filter to remove problem frequencies from the modulator. If your particular vocoder isn't playing ball, try compressing the vocal on the way into it, or compressing the audio track.

Pitch and carry

The range of effects you can generate with a vocoder is vast. Although naturally associated with voice effects, vocoders can be used with all sorts of sounds and, indeed, they can create many unique sounds suitable for a wide range of music. We won't go too far down the road of vocal processing here because we have a gargantuan Vocal Processing feature in next month's issue, so we'll round off this Ten Minute Master by suggesting ways of using a vocoder with mainly non-vocal sounds.

Drums are a firm favourite for vocoder processing. Run a drum loop through a vocoder using a pad for the carrier. Adjust the balance between the original signal and the modulated signal to determine how much of the processed sound you get. Adjust the filter settings so that it lets through more high frequencies to accentuate the hi-hats and mix these with the original sound. And try this way around – use a drum loop as the carrier and your voice as the modulator. Try speaking individual words and phrases, and then take a deep breath and roll out a whole load of words in one breath. Interesting...

We've already said that the carrier should match the modulator for frequency content and although most vocoders rely on a handful of tried-and-tested waveforms, it's worth experimenting with other carrier sounds such as wind, surf, rushing water, crowd noises and so on. Run a drum loop through this to produce a 'natural' drum sound.

Try reversing modulator and carrier signals. Knowing how vocoders work, you'll realise that a static modulator (such as a pad sound) will probably not produce interesting results. Dynamic natural sounds, on the other hand, may produce a few surprises...

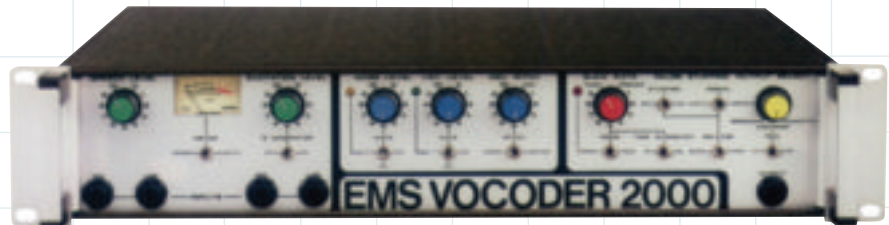
Mix 'n' match

Not all vocoded effects have to be 'in yer face' – many intriguing and subtle effects can



Σ Korg's VC-10, released in 1978, was used by Keith Emerson, Tomita, Rick Wakeman, Klaus Schulze and Tangerine Dream.

∇ The EMS Vocoder 2000 was one of the earliest commercially available vocoders.



be created by mixing the processed signal with the original. Most vocoders enable you to set the balance between the original and the modulated signal, but if you can't, it's easy enough to save the processed version, import it into your sequencer and adjust the balance in the mixer.

Try delaying the processed version a little to create a soft echo. Also, try panning the original and the processed signals to opposite sides of the stereo field. Take this a stage further by creating several copies of the processed signal, delay each one and place them at different pan positions to create a ghostly echo that pans around the stereo field.

You don't have to vocode every sound in a track. Here's an idea that may be best implemented on a drum track, but it will work with vocals and other tracks, too. From a track, cut out specific sounds and place them on their own track. On a drum track it could be the hi-hats or snare; with vocals it could be certain words or phrases. Now you can process just those parts of a sound. In many ways this can end up being more exciting than processing the entire track as the listener will be waiting for the section of music to come around that contains the 'strange' sound.

Try combining the last two techniques; create a processed version of individual drum hits or words, delay it a little and add it to the original to create a vocoded echo effect.

Vocoders are just about the most exciting, versatile and contemporary units for adding interest to your music, so experiment... **MTM**

TECH TERMS

VCA

Voltage Controlled Amplifier. Typically, a synthesizer module that adjusts the volume of a signal according to its input. In a vocoder, the controlling signal is derived by analysing the frequencies in the modulator.

Voiced/unvoiced

The part of a vocoder that detects voiced (tonal) and unvoiced (noise) sections in a speech signal and makes the vocoder react accordingly.

Glide/slew

A control that smoothes the change between two discreet values. It's typically used in synthesizers to slide or glide between the pitches of two notes.

FURTHER INFO

More information

Wendy Carlos on vocoders
www.wendycarlos.com/vocoders.html
 Other sources
www.vocoder-plugins.com
www.cim.mcgill.ca/~clark/nordmodularbook/nm_speech.html
www.lonestar.texas.net/~mr88cet/VocodingWebDemo/VocoderDemo.html
www.members.tripod.com/werdav/vocbaema.htm

More vocoders?

Adi Winman takes a look at using Reason 2.5's new BV512 Digital Vocoder in his tutorial starting on page 58. And we'll be taking a much closer look at vocoders and other forms of vocal processing in next issue's cover feature.