ByteNoise

Envelope

Envelopes, also known as contours, are waveforms that don't repeat. Like the waveforms generated by LFOs, they move back and forth far too slowly to be audible, and are never heard directly. Instead, they are used to control other parameters, such as a filter's cutoff point or an attenuator's level. This is what enables synthesisers to fade in a note when you press a key, then fade it out again when you let go of that key.

When you press down a key on a monophonic, analogue synthesiser, it does two things in addition to changing the oscillator's frequency: it activates a trigger, which is a quick electronic pulse, and it opens a gate, which is a sustained electronic signal. Playing another note while still holding down the first one causes the trigger to be activated again. Letting go of all the keys closes the gate. The signals for the trigger and gate are usually fed through to an envelope generator, which uses this information to produce envelope waves in time with the individual notes.

There are several different kinds of envelope, but the most popular are the decay, trapezoid and ADSR types.

Decay envelope

The simplest kind of envelope is a decaying line or curve. It's useful for percussive sounds. For example, white noise that's

being attenuated with a decay envelope makes a simple but effective snare drum substitute. As the decay envelope doesn't sustain a sound, it only makes use of the trigger, not the gate.

Trapezoid envelope

A trapezoid envelope rises to its highest point, then stays at that constant amplitude until the gate controlling it is turned off. It then falls back down to zero. The trapezoid envelope is good for attenuating organ and pad sounds, especially long notes that slowly fade in and out.

ADSR envelope

By far the most common envelope is the surprisingly versatile ADSR envelope, named after its four parameters: attack, decay, sustain and release. It is similar to the trapezoid envelope, except that after it rises to its peak at the start (the attack time), it then falls back down to a more comfortable level for the sustained part (the decay time and sustain level). As with the trapezoid envelope, once the gate is closed, it falls back down to silence (the release time).

When used the way it's intended, the ADSR envelope is suitable for piano-style sounds, although its popularity is probably mostly due to its versatility: by turning the attack time, sustain level and release time down to zero and setting a decay, it emulates a decay envelope; by turning the decay time down to zero and the sustain level up to the maximum setting, it emulates a trapezoid envelope. Because of this, the ADSR envelope generator has essentially made dedicated decay and trapezoid envelope generators obsolete.

More complex envelopes

There's no reason to stop at the ADSR envelope. Some synthesisers let you specify many different points in time and amplitude, connecting the dots with either straight lines or curves. These can be much more versatile than ADSR envelopes, but are curiously rare. Most people still seem to be content with ADSR envelopes, and they have become the standard.

References

- Sound on Sound: Synth Secrets Part 3: Modifiers & Controllers