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Creating Synthesizer Sounds for Electronic Music
The Synthesis Glossary

Amplifier

In most synthesizers, the final stage (before the delay effects) is an amplifier (volume control). This is almost always modulated with an envelope and creates the volume contour of the individual notes. It is often known as the "VCA" or Voltage Controlled Amplifier.

Band Pass Filter

An extreme filter that allows a range of frequencies pass while rejecting frequencies both above and below this range or "band" of frequencies.

Band Reject Filter

An extreme filter that cuts a narrow range of frequencies, allowing frequencies above and below this range to pass through the filter. Also known as a "notch filter".

Cutoff Frequency

One of the most important controls on a synthesizer, this is the center frequency of a synthesizer filter and it is often modulated by direct control, envelopes, and LFO's.

Drive/Distortion

Distortion is non-linear, which in this case means it's effect on the sound is dependent on volume---the louder the input the more distorted the output. Usually, drive will be mostly harmonic distortion--- the frequencies present at the output are all harmonics of frequencies present in the input. A sine wave input can result in a complex output (the louder the input the more complex the output), but every frequency present in the output will be a harmonic of that sine wave input. Putting a highly dynamic signal into a distortion will make the loud moments brighter (as upper harmonics are added), and the quiet notes will remain unaffected; distortion turns volume variations into timbre variations.

Envelope

Envelopes are general-purpose modulators. The typical envelope is divided into 4 stages. Attack, Decay, Sustain, Release---ADSR for short. Manipulating the envelope parameters defines a "path" that is run every time the envelope is triggered, usually by a MIDI note-on event. This path is configured to modulate, or change, another parameter. The most important envelope destination is the amplifier. It is important to note that Attack, Decay, and Release are all amounts of time, but sustain is a level. The envelope starts at zero with a MIDI note-on event and proceeds to full level over the attack time; then it continues to the sustain level over the decay time; it stays at the sustain level until a MIDI note off event is received, at which time the envelope returns to zero over the release time.

Filter

A filter is a frequency-specific volume control. Filters are the sound shaping portion of the synthesizer. Every filter description will include both amplitude and frequency information as in "cut the highs." "Cut" is amplitude reduction, and "the highs" is the frequency description. In this example you would choose a Low Pass filter, the most common synth filter type.

Glide

On a mono synth (and some poly synths for a very cool sound) the pitch of a note can be made to glide from note to note, like a trombone or violin player. The amount of time it takes to get from note to note is the glide time (portamento time). Usually glide will need to be enabled and the glide time set. On many synths there will be a legato/glide option near the portamento time control. In legato mode, only overlapping notes glide; this mode gives you more control over the gliding. The sound of some notes gliding and some notes jumping is very common in modern electronic music.

High Pass Filter

An extreme filter that allows the frequencies above the set cutoff frequencies to pass through and rejects the frequencies below the cutoff frequency.

Keytracking

This can be used to control the timbre of a sound based on what note is played. Keytracking is modulation signal created by keyboard position, playing higher on the keyboard generates a higher modulation.

Low Frequency Oscillator (LFO)

A Low Frequency Oscillator, LFO for short, adds steady cyclic motion to a synth parameter. While it is a general-purpose modulator that can control a variety of parameters, creating a vibrato effect is its most common usage. To create vibrato, the LFO's destination must be set to the frequency of the oscillator. This particular modulation is so important that many synthesizers have a dedicated LFO specifically for vibrato, internally set to a sine or triangle shape and a destination of the oscillator frequency. The LFO shares many of its important parameters with the oscillator: wave shape, rate (frequency). Notice the range of the rate parameter; an oscillator runs at audible frequencies (20Hz to 20,000 Hz), where an LFO runs at much lower frequencies (0Hz to 20Hz--- though many synthesizer's LFOs can run faster for interesting effects).

Low Pass Filter

The most common synthesizer filter. A Low Pass Filter is an extreme filter that allows all frequencies below the cutoff frequency to pass through while rejecting (attenuating, lowering) those frequencies above the cutoff frequency.

Modulation

Modulation is the time dimension of synthesis: if anything changes in a synth it is the result of Modulation. Modulation always requires a

modulation source, a modulation destination, and a modulation amount. The standard Modulators are Direct control (key, velocity, CC, pitchbend, and pressure), Low Frequency Oscillators, and Envelopes. The most common destinations are oscillator frequency, filter cutoff, and amplitude. "Voltage Controlled" indicates that a specific parameter is a modulation destination.

Non-sustaining

All instrumental sounds can be placed in one of two categories: sustaining or non-sustaining. If the instrument gets an initial burst of energy then is left to resonate and decay (striking or plucking) then it is a non-sustaining instrument. If energy is being added to the instrument over the course of a note (blowing, bowing, mechanically vibrating), then it is a sustaining instrument.

To emulate non-sustaining instruments, the sustain portion of the amplitude envelope is zero.

To emulate sustaining instrumental sounds, the sustain portion of your amplitude envelope is non-zero.

Notch Filter

An extreme filter that cuts a narrow range of frequencies, allowing frequencies above and below this range to pass through the filter. Also known as a "band reject".

Oscillator

Oscillators create the sounds in a synthesizer. Typically, they generate a variety of waveforms such as saw, sine, square, triangle, and noise. The visual shape of the looping waveform often describes oscillators. In subtractive synthesis, an oscillator with a wide spectral content, like sawtooth, starts the signal. Next, a filter is used to carve out any unwanted frequencies. Think of the oscillator like marble and the filter a sculptor's chisel. In additive synthesis many simple waveforms (usually sine waves) are added together to create a complex spectrum; they are usually configured in multiples of a common frequency to create a harmonic spectrum. An organ with draw bars is a good example of an additive synth: as you bring in the bars, upper harmonics are added to the overall timbre.

Phase

Oscillators create repeating patterns, the location within that pattern is the "phase" of the oscillator. Phase can be described as a percentage going from 0 to 100% (and repeating after that, 150% is the same as 50% because the waveform repeats exactly), or as degrees (0 degrees to 360 degrees).

Portamento

On a mono synth (and some poly synths for a very cool sound) the pitch of a note can be made to glide from note to note, like a trombone or violin player. The amount of time it takes to get from note to note is the portamento time. Usually glide will need to be enabled and the glide time set. On many synths there will be a legato/glide option near the portamento time control. In legato mode only overlapping notes glide;

this mode gives you more control over the gliding. The sound of some notes gliding and some notes jumping is very common in modern electronic music.

Priority

Priority chooses which notes are kept active once the maximum voices are reached. The most common setting is Last, which keeps the most recently played note active and starts turning off the oldest notes. Top is also common and can work really well when you are layering a mono and poly synth to highlight the highest note in the voicing. Bottom can be used in a similar manner to bring out the bass. On sampled instruments, the cutting off of notes above the max polyphony is often referred to as voice stealing.

Pulse Width Modulation (PWM)

A rectangle wave is a repeating cycle, it spends a portion of its time high and a portion of its time low. A square wave has an equal portion of time up and down, but this can be varied. The proportion of time up and down

Resonance

When talking about low and high pass filters, resonance is a boost at the cutoff frequency. A high resonance will dramatically boost partials that are at the cutoff frequency and bring attention to the filter itself (and the filter's modulation). The higher the resonance, the more pronounced the effect. Up to a point, eventually the filter will "start to self-oscillate." When this happens the filter acts like an additional sine wave oscillator.

Retrigger

Retrigger is when the Low Frequency Oscillator starts again at its initial phase. If an LFO or oscillator is set to retrigger with each note, then the LFO will return to this initial phase with each note-on. This is related to "gate"; a gate signal will retrigger an oscillator.

Sawtooth Wave

The visual shape of the looping waveform often describes oscillators. A sawtooth waveform rises or descends linearly over the course of the loop. When used as an LFO, it can create repeated ramps (ascending or upward sawtooth) or pulses (descending or downward sawtooth). If used as an audio oscillator, the waveform of the oscillator controls the relative levels of the partials. A sawtooth waveform creates a very full spectrum and is a great starting point for subtractive synthesis.

Sine Wave

A sine wave is the simplest and smoothest of waveforms. When used as an LFO, a sine wave creates smooth periodic variation. If used as an audio oscillator the sine wave creates energy at a single frequency.

Slope (Filter)

A filter slope is described in decibels per octave. A common slope is 12 dB per octave. On a low pass filter if you were to measure the reduction in amplitude an octave above the cutoff frequency you would find that it is reduced by 12 decibels. With a slope of 24 dB per octave on a low pass filter, the amplitude reduction an octave above the cutoff frequency is reduced by 24 dB. So, the higher the "dB per octave" the steeper the slope.

Square wave

The visual shape of the looping waveform often describes oscillators. When used as an LFO, a square wave will create an alternation between two extremes. As an audio oscillator, a square wave creates a "hollow" timbre that has only odd harmonics. A square wave has a pulse width of 50 percent: it spends an equal amount of time high and low. If the oscillator has a PWM modulation destination, the percentage of time up and down can be varied.

Sustaining

All instrumental sounds can be placed in one of two categories: sustaining or non-sustaining. If energy is being added to the instrument over the course of a note (blowing, bowing, mechanically vibrating), then it is a sustaining instrument. If the instrument gets an initial burst of energy then is left to resonate and decay (striking or plucking) then it is a non-sustaining instrument.

To emulate sustaining instrumental sounds, the sustain portion of your amplitude envelope is non-zero.

To emulate non-sustaining instruments, the sustain portion of the amplitude envelope is zero.

Sync

Sync is used a variety of ways in synthesizers. In LFOs, sync can be used to set the LFO rate in metric units (quarter, eighth, sixteenth notes) related to your DAW tempo. In audio oscillators, sync causes the oscillator phase to restart based on a second oscillator and can be used to create a wide range of aggressive timbres.

Timbre

The character or quality of a musical sound.

Triangle wave

The visual shape of the looping waveform often describes oscillators. A triangle wave rises up and down with straight lines. When used as an LFO, this wave can create a smooth periodic waveform, similar to a sine wave. If used as an audio oscillator, a triangle waveform includes only odd harmonics, like a square wave, but the upper harmonics are attenuated. It sounds like a filtered square wave.

Unison/Unisono

Unison enables multiple, slightly varied, voices to be used for each played note. Often the unison voices are panned dramatically and detuned slightly.

Vibrato

Vibrato is a steady variation in pitch (use a semitone for depth and 5Hz for rate as a good starting point for natural human vibrato).

Voices

Generally, if a 4-note chord is held down, the synth is using four voices, however the number of voices is not *always* the same as the number of

notes held. The voices section will limit the number of simultaneous notes; this is done to limit the CPU load and for creative purposes. There is an overall division between poly (many notes at once) and mono (one note at a time).

In mono mode, there are additional legato/portamento controls that control how the pitch glides from one note to the next. Often synths will have a unison/unisono feature designed to create thick ensemble sounds by playing multiple voices with slightly different qualities (pitch, timbre, onset delay). These typically multiply the number of used voice: if your Unsion is set to 2 and max voices is set to 4, you can only play 2 notes at once before the synth starts "stealing" or stops playing notes.

Voltage Controlled Amplifier (VCA)

In analog synthesizers, variations in voltage are used to modulate (change, vary over time) various parameters. In a VCA, the most common parameter to modulate is amplitude.

Voltage Controlled Filter (VCF)

In analog synthesizers, variations in voltage are used to modulate (change, vary over time) various parameters. In a VCF, the most common parameter to modulate is filter cutoff.

Voltage Controlled Oscillator (VCO)

In analog synthesizers, variations in voltage are used to modulate (change, vary over time) various parameters. In a VCO, the most common parameter to modulate is the frequency (pitch) of the oscillator.

Waveform

Oscillators described by the visual shape (sawtooth, square, and triangle), or by the trignometric function used to generate the shape (sine). LFOs and audio oscillators use the same waveforms.