Modulation algorithms

Crossfade
The carrier and modulator are crossfaded, using a constant-power law. TIMBRE controls the crossfading position – both signals are equally mixed at 12 o’clock.

Crossfolding
The carrier and modulator are summed, a tiny bit of cross-modulation product is added to spice things up, and the resulting signal is sent to a wavefolder, the amount of which is controlled by TIMBRE.

Diode ring-modulation
The carrier and modulator are crudely multiplied, using a digital model of a diode ring-modulator. TIMBRE post-processes the resulting signal with a variable amount of gain (and emulated diode clipping).

Digital ring-modulation
A gentler version of the previous algorithm which uses a proper multiplication operation in the digital domain. TIMBRE post-processes the signal with a gain boost and soft-clipping.

Exclusive-or modulation
Both carrier and modulator are converted to 16-bit integers, and the two resulting numbers are XOR’d bit by bit. TIMBRE controls which bits are XOR’d together.

Comparison and rectification
A handful of signals are synthesized through comparison and rectification operations typical of octave pedals. TIMBRE morphs through these signals.

Vocoder
A digital model of a classic analog vocoder, with a bank of 20 analysis and 20 synthesis fourth-octave 48dB filters. The modulator sub-band signals are processed by envelope followers which control the gains of each of the carrier sub-band signals. TIMBRE warps the connections between the modulator’s envelope followers and the carrier’s gain elements – effectively shifting up or down the formants extracted from the modulator signal.

As the ALGORITHM knob is turned clockwise, the release time of the envelope followers is increased. By turning the knob fully clockwise, the release time becomes infinite, and the spectral envelope of the carrier is frozen.

Internal oscillator
Press the INT. OSC button (C) to enable the internal oscillator or select its waveform.

Because cross-modulation algorithms work best with harmonically simple signals, while vocoders work better with harmonically rich signals, the available waveforms are different depending on the active algorithm: sine, triangle and sawtooth for the former, and sawtooth, pulse and low-pass filtered noise for the latter.

Some of the inputs, outputs or controls operate differently when the internal oscillator is enabled:

- The LEVEL knob (D) and CV input (1) control the oscillator frequency.
- The carrier audio input (5) phase-modulates the internal oscillator, or feeds an external source of noise into the low-pass filter.
- The AUX output (8) contains the signal generated by the internal oscillator.
About Warps

Warps blends and combines two audio signals through a variety of cross-modulation algorithms. Most of these sonic transformations make the distinction between a carrier signal and a modulator signal: the former will be filtered or modulated to acquire some of the characteristics of the latter. Warps also includes a digital audio-rate oscillator which can replace the external carrier signal.

Installation

Warps requires a -12V / +12V power supply (2x5 pin connector). The red stripe of the ribbon cable [-12V side] must be oriented on the same side as the “Red stripe” marking on the board. The module draws 5mA from the -12V rail and 110mA from the +12V rail.

Online manual and help

The full manual can be found online at mutable-instruments.net/modules/warps/manual

For help and discussions, head to mutable-instruments.net/forum

Front panel

Controls

A. Modulation algorithm. Selects which signal processing operation is performed on the carrier and modulator.

B. Modulation timbre. Controls the intensity of the high harmonics created by cross-modulation (or provides another dimension of tone control for some algorithms).

C. Internal oscillator state. Enables the internal oscillator and selects its waveform.

Inputs and outputs

1. External carrier amplitude or internal oscillator frequency. When the internal oscillator is switched off, this knob controls the amplitude of the carrier, or the amount of amplitude modulation from the channel 1 LEVEL CV input (1). When the internal oscillator is active, this knob controls its frequency.

2. Modulator amplitude CV input. This CV input controls the gain of the modulator input. When a signal is patched into this input, the amount of CV modulation is controlled by the Modulator amplitude knob (E).

3. Algorithm CV input.

4. Timbre CV input.

5, 6. Carrier (1) and modulator (2) audio inputs (modular level).

7. Modulator output (1×2). This is the main audio output.

8. Auxiliary output. Signal from the internal oscillator (when it is enabled) or sum of the carrier and modulator, post VCA.