Vulpus Labs

Beverley

Introduction

Beverley is an advanced bitcrusher and harmonic distortion module designed for musical applications.

Unlike traditional bitcrushers that simply quantise an input signal to reduce bit depth, Beverley combines intelligent gain control, gamma correction, and smoothed quantization to create harmonically rich distortion suitable for guitars, drums, synths, and other audio sources.

Key Features

- Interpolated bit depth for smooth parameter sweeps
- Gamma correction for dynamic response shaping
- Smoothed quantization from soft saturation to hard digital steps
- Automatic peak-controlled gain compensation
- Asymmetric and symmetric crush modes
- CV modulation of key parameters
- Stereo processing with mono compatibility

Theory of Operation

Beverley runs each input signal through the following stages:

1. **Normalisation**: the input signal is normalised from the expected input range -5v to +5v to the bipolar unit range -1 to +1.

2. **Gain**: either a fixed amount of gain (up to 20dB), or an automatically detected gain correction amount, is added to the input signal.

3. **Hard Clipping**: the gained signal is hard-clipped within the range -1 to +1.

4. **Gamma**: the clipped signal is modified using a power-law transform, shifting the amplitude distribution of the signal while keeping it within the range -1 to +1.

5. **Quantisation**: the signal is quantised, with the number of quantisation levels corresponding to the chosen bit depth. Fractional bit depths are handled by quantising to the lower and upper adjacent whole number bit depths, and interpolating between the two results.

6. **Smoothing**: the quantised signal is smoothed by an amount ranging between 0 (fully quantised), 0.5 (“S”-shaped smoothstep-function transition between quantisation levels) and 1.0 (transparent reconstruction of the original signal)

7. **Reverse Gamma**: the inverse of the power-law transform applied in **3** is applied

8. **Reverse Gain**: the gain applied in **2** is reversed

9. **Reverse Normalisation**: the bipolar unit range of the result is mapped into the expected output range -5v to +5v.

The gain function enables quieter signals to make use of the full quantisation range, with the reverse gain stage compensating for the amplitude boost applied. With auto-gain enabled, the gain follows the envelope of the input signal, so that quieter and louder parts of the signal are broken down into the same number of quantisation intervals.

The gamma function shifts which amplitude levels within the signal are distributed into the most quantisation levels, which affects the dynamic impact of the effect (i.e. its behaviour when processing attack transients vs its behaviour when processing the sustained part of an input).

The smoothing function works a little like a plain “mix” between quantised and unquantised signals, only with an intermediate level that mathematically smooths out quantisation while preserving rapid transitions between quantisation levels.

Controls

Stereo inputs and outputs are at the top of the panel. If only the **L** input is connected, the left signal is copied to the right channel.

Set the **GAIN** amount (0-20dB) with the yellow gain knob, or set the **(AUTO)** toggle to engage envelope-following gain correction.

Set the **GAMMA** amount with the blue knob, and modulate it with the **GAMMA** CV input at the bottom of the panel (modulation amount is controlled by the knob above the input).

Set the **BIT DEPTH** amount with the purple knob, and modulate it with the **DEPTH** CV input and modulation amount knob at the bottom of the panel.

Set **SMOOTHING** with the green knob.

CRUSH MODE switches between *assymmetrical* crushing (normal bitcrushing behaviour, where the entire signal range is quantised) and *symmetrical* crushing, where the positive and negative parts of the signal range are independently quantised.

Credits and Acknowledgements

Beverley was written by Dominic Fox in September 2025.

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