Detour (part of the hora VCO-VCF-VCA plugin)
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Introduction

Detour is a Vector Phaseshaping based synthesizer. It offers an advanced model of the Vector Phaseshaping Synthesis and CV inputs for every parameters. The vision that has guided the Detour’s development is based on my researches as part of a hardware digital synth’s project.

This model has been selected for the wide sound variety it can produce compare to the needed CPU load.

The vision of this is also influenced by 80s phase distortion synthesizers and the sound can be very closed to the classiccasio CZ series.

The specific sound of detour is due to the model that can cover the classical PDS setting (and more), to the filter and to the internal envelope generator.

The ADSR is a bit different from those usually developed for eurorack/VCV modules and the VPS model is exploited in a specific way which offer to set two inflection points.

You can refer to this paper from the IRCAM for more thechnical details about the model:
http://recherche.ircam.fr/pub/dafx11/Papers/55_e.pdf

Detour is part of the Hora-VCO_VCF_VCA plugin, it is available on both free and commercial version of the plugin, the version includes with the free version is monophonic and the one coming with the commerical plugin offer 16 voices of polyphony.

Lexicon

PDS: Phase distortion synthesis.
VPS: Vector Phase shaping Synthesis.
D: Horizontal (x axis) coordinate of an inflection point.
V: Vertical (y axis) coordinate of an inflection point.
The VPS synthesis is a variant of the PDS.

The main idea is to distort the phase of an oscillator. To explain it simply, the phase is a value going linearly from 0 to 1 at a rate corresponding to the desired pitch. In VPS synthesis, this phase is converted to an inverted cosine wave or, in more mathematical words, the output is equal to zero minus the cosinus of the phase (radians).

To distort/shape the phase the PDS allows to modify the D parameter of the inflection point. If $V = 0.5$ set $D$ from 0.0 to 0.5 gives a progressive/continuous cosine to saw morphing.

If $V = 1.0$ set $D$ from 0.0 to 0.5 gives a pulse and variable pulse width depending on the $D$ value.
The VPS allows to modify both V and D parameters (so to move the inflection points on both X and Y axis).

This allows the producing of formants especially noticeable when V is a bigger than 1 and multiple of 0.5 (1.5, 2.0, 2.5,...), With these particular D settings, the number of of ripple before the inflection point is equal to V and the number of ripples after this is equal V — 1.

![Diagram with graphs showing the effect of V and D parameters on formants.](image)

- V = 3.0
- D = 0.5
- V ripples (3)
- V - 1 ripples (2)
Detour offers continuous V and D setting. For a deeper model it also offers two V and two D parameters (red and blue). These specific settings are used alternately on a complete wave cycle giving complex waves spread out over two periods. The sounds obtained with very different red and blue V/D settings are interpreted by ears as lower by one octave. Passing progressively from perfect same V and D values for both blue and red parts to different settings gives a sound morphing to a different timbre and a lower pitch on the same time. On detour, the ranges for those parameters are 0.5 to 4.0 for V and 0.5 to 0.0 for D.
The two blue and red Circles are used to change V and D initial values and are linked to the V and D knobs. The hexagonal objects are used to change the level of CV modulation sent to the concerned parameter. The triangular objects are used to change the level of internal envelope generator (ADSR) sent to the concerned parameter.

**E. G:** Move the blue triangular objects on the vertical axis will modify the level of the envelope sent to the V parameter (in other words, the vertical position of the inflection point) of the period corresponding to the blue color.

Every objects and circles work the same way:
The vertical (Y) position refers to the V value, the horizontal (X) position refers to the D value (for the period corresponding to the object/circle color).
The V and D circles are automatically sticked together if the user drags one of these (using the mouse) over the other. This is made to allow easy modifying of both V and D parameters on the same time.
The X and Y inputs are optimized to be used with two dimensional pads. By using this inputs the entire V and D range is cover with 0 to 5 volts CV. (instead of 10 volts for the modulation inputs).

The envelope generator is very different from the usual VCV envelopes (a bit less snappy). The envelope is made to avoid unmusical noises/clicks and offer a very specific attack sound which can remind some older digital synthesizers and seems very musical and interesting to my ears, especially on polyphonic sounds. It offers the classical ADSR parameters and a button to set the long release feature. The module can be used like an oscillator if nothing is connected to the gate input (of course the internal envelope isn’t used in this mode) or as a complete synthesizer if the gate input is connected.

The filter is made for low CPU usage and good performances. It offers LP BP or HP modes. The resonance can be pretty high but doesn’t auto-oscillate. This is also a voluntary behaviour which remind some older digital (and also a few analog) polyphonic synthesizers. It is controlled by the green objects/circles, this objects are uni dimensional and concern the frequency parameter. The green circle refers to the initial frequency and resonance, the horizontal position is linked to the frequency and the vertical position is linked to the resonance of the VCF.