Jacobi^{17} SurfBox Synth

A Synth for LMMS

The synth is a design combining varied spectral content generation methods, and simple subtractive state variable filters to cut out higher harmonics. Features are built in which simplify the interface.

- There is only a ramp waveshape to the oscillators
- Each oscillator is a phase modulated chain feed
- The final oscillator feeds back to the first
- Oscillators have mod (in) and ratio controls only
- The post oscillator filters have frequency and resonance controls only

The above scheme makes for four independent controls per oscillator. They control the tuning ratio (or interval), the modulation from the previous oscillator (or the last in case of the first), and an output filter frequency cutoff and resonance of a 2 pole low-pass filter. There is no envelope control, as this is done via the LMMC synth builtin envelope generator.

All oscillators share a common base waveform. This is just the DCO counter and is a sawtooth wave. This simplifies things considerably. Less harmonics can be made by the filter on each DCO. The decision to use three DCO, and rational ratios only, leads to a large number of base timbres. Automation can be used for dynamic control of the timbre.

The post filter output of the last DCO is fed into a wave shaper. The wave shaper is perhaps more complex to understand, as the wave shape curve is mathematically derived. The net result is a dynamic wave shape controlled by quite a few controls.

- Slide – alters the responsiveness of the controls, like a timbre portamento
- Drive – the applied drive to the shaper, like a kind of timbral volume
- PQ – the mix between the timbral pair, varies depending on other controls
- Tort – the complexity index, generally makes the timbre more harmonic
- Generator – the nature of the generation group, steps through the generators
- Bank – the preset switching of the other five shaper controls

This makes for 18 controls in total. A complex enough synth for generating many timbres. The output of the shaper is not filtered, and high values of tort and drive will cause likely loud and high pitched harmonics. You are advised to post filter the synth using the instrument FX to band limit such harmonics. Bank and slide are added to the oscillators too, just for fun.

That's enough of an operational specification, playing is the acid test as it were.

Simon Jackson, KRT Instruments

Extra Optional Controls

Due to the note rendering process in LMMS, it is not possible to place effects units not the instrument before the LFO and envelope which are effectively applied post instrument. This is a limitation of efficient polyphonic rendering, of not running an effect on each note, but only on the full instrument (with LFO and envelope) output.

The extra controls added to the Jacobi allow extra expressional control, and are banked in the usual bank rows. This places effects local to an oscillator, and there is a post shaping filter. Considering the timbral effect of each oscillator, the controls are customized to each row, and its general effect on timbral quality.

1st Spreading	SPRD	Fade Harmonic Content (Exponential)	Gaussian Noise Modulation
2nd Harmonic	HRMC	Fade Harmonic Content (Exponential)	Rasp Dither Frequency (Hi-Lo PWM-ish)
3rd Fundamental	FUND	Walsh Sub Octave	Sub Sub Octave

The FHC allows an effect similar to a very simple envelope generator, there is no attack, just a release rate controlled by the fade. In the centre position there is no fade. Lower positions increase the fading speed, and higher positions are use an inverted and offset decay to make ever slower increasing harmonic content.

GNM allows Gaussian noise to added into the modulation (after the MOD pot), to give some random character to the DCO. RDF on the other hand plays for each two cycles of the waveform, one sped up and one slowed down for the same timing over two waveforms. The range is from no effect to a 0.5:1.5 effect.

WSO and SSO are designed to invert every second waveform (or two contiguous out of every four for SSO), and take these extra two waveforms, gain them, and put them through the DCO filter along with the main DCO wave. This has the effect of generating harmonic sub octaves.

The reasoning behind which DCO has which effects was complex, and based somewhat on the internal model in my head of the sounds from a DX7 (from experience). Keeping the synth simple yet at the same time not hiding some of the best tweaks was the optimizing concern. Big fat base from the sub octaves, wide harmonic content from the RDF, natural harmonic spreading from the GNM, and some simple modulation style envelope effects from the FHC.

For actual real chaos noise the MOD on SPRD should be turned up high, along with high CUT values starting from the top, along with low REZ values. This is mainly due to the filter implementation using a constant maximum level algorithm, where high REZ values make the filter into band-pass mode instead of low-pass with resonant peak.

Extra Plugin Development Ideas

- A twist on the Peak Controller (Project FEEDBACK)
- Some kind of nuts delay (Project SQUIRAL)
- A spectral compressor (Project EARS)
- A four track audio in and tape transport (part of Project FEEDBACK?)