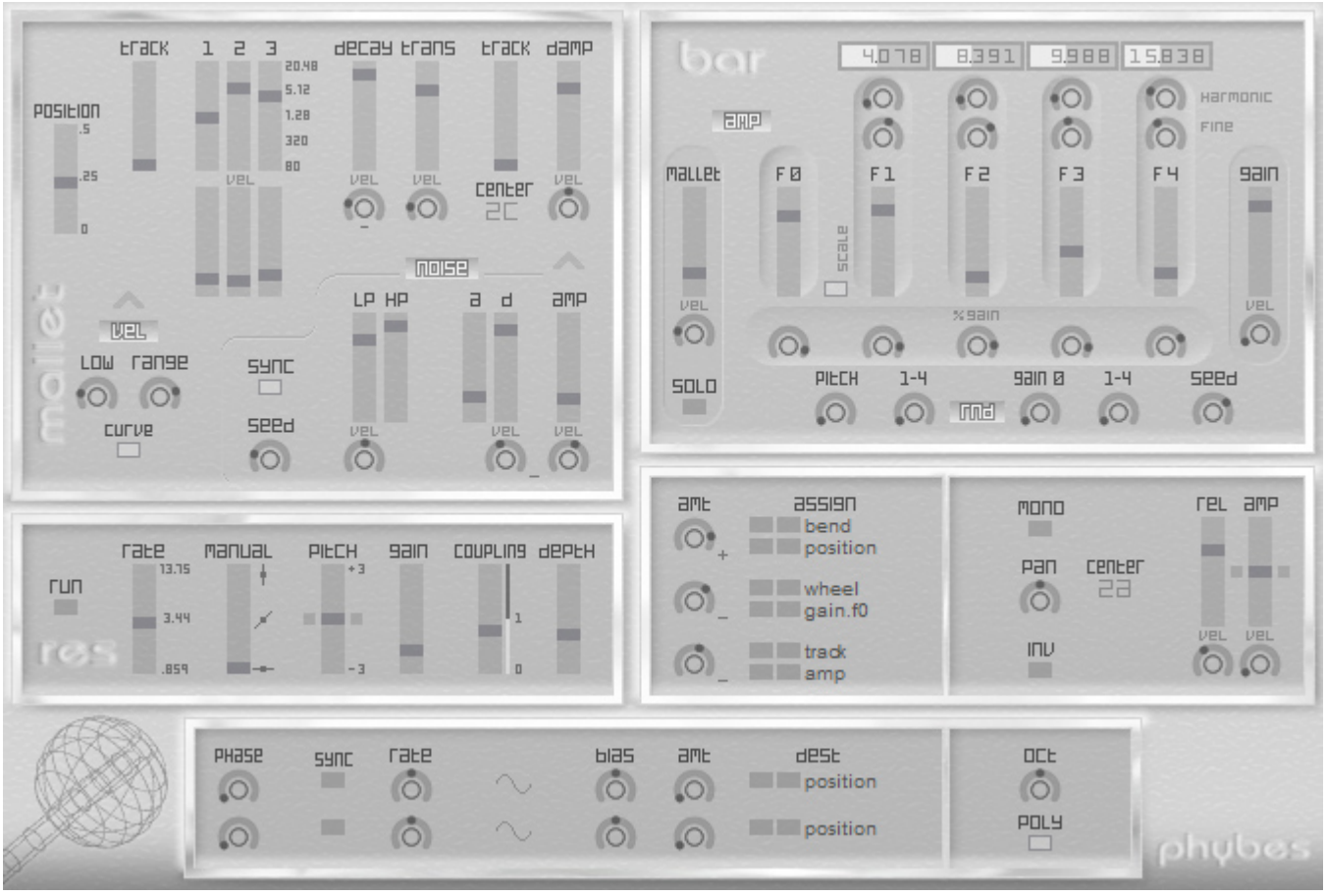


Phybes VST

Phybes is a physically modeled vibraphone. In waveguide models of strings, material stiffness can be modeled with allpass filters. The increased stiffness of bars requires high order filters unsuitable for modern cpu environments. The banded waveguide solution was proposed in 1999 by Georg Essl and Perry Cook and achieves a similar result. Banded waveguides filter the signal at the fundamental and partial frequencies, and delay each tap proportionally to its frequency.

The banded waveguide is coupled with a modulated resonator and mass-spring impulse to provide a low resource emulation with pleasing dynamic timbrality suitable for many compositional applications.

bar

Each voice employs five bandpass filters for modeling the fundamental and first four partials. For many vibraphones, this is sufficient to model partials to nyquist at 44100 Hz. Each partial is set as a harmonic integer from 2 to 64, which can then be fine tuned by plus or minus 1 to set the required partial.

Sliders under each frequency set the volume of the partial. The `scale` switch scales volume by the partial ratio at the center of the slider range (and twice at the highest setting as these sliders have a linear scale) eg. a partial set to the 5th harmonic would be 1/5th as loud in the center. All sliders can be fine tuned by holding [ctrl].

Overall feedback is set with the `gain` slider. Gain of each partial may be set in proportion to produce faster decays.

Randomisation functions are derived from the note value and seed parameter. Pitch randomisation applies the same value to all frequencies, 'pitch 1-4' applies different random values to each partial to a maximum range of -/+2 semitones.

All randomisation controls are scaled logarithmically to produce very subtle effect at low settings.

virtuality and reality

This instrument epitomises considerations of computational modeling. The pursuit of effective instrumental emulation appreciates the performance advantages of modeling in comparison with sampling. The simplicity of the computational form can be more apparent when resonant impulse and waveguide frequencies are aligned, which is a consideration in patching. The effect of partial ratios on sustain will also be observed.

Internal softlimiting is used in the circuit. It generally doesn't touch the signal unless there are overlapping partials.

The partial data in the presets was derived using Praat for formant analysis (the help file is very courteous here). Whereas other percussion sounds are included in the presets, the partial count here is most suitable for efficient mallet instrument emulation.

mallet

The dynamic tonality of the mallet is crucial to effective emulation in the simplified computational form, being that only five paths are used to convey the impression of an acoustic solid. The highly complex interaction of a mallet being percussed and dragged is prohibitive to VST applications.

While the dynamic performance of mass-springs is advantageous to modeling, springs oscillate at a resonant frequency. The third order mass-spring (as used in Piamo) provides a strong harmonic profile (eg. three strong frequencies) which can have unconvincing effects on the simple five band bar model, even with strong boundary clipping.

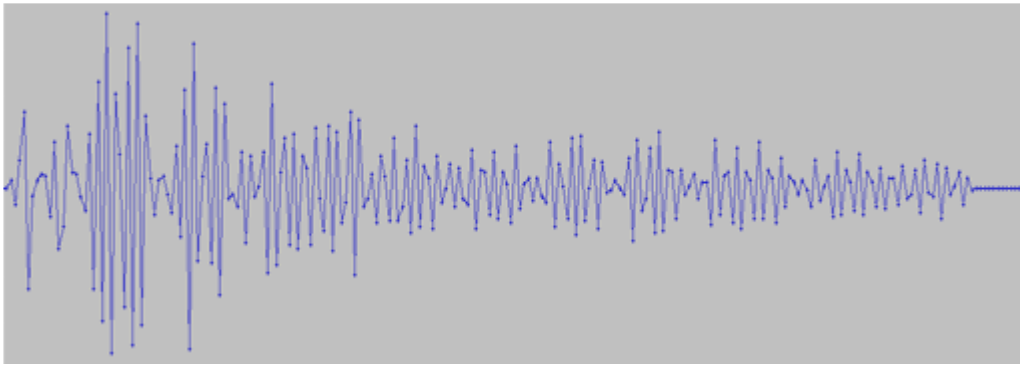
The mallet has a filtered noise source which modulates the first order mass-spring. The noise source can be synced for a recallable impulse. Ideally, it should add harmonics to the impulse without being discrete enough to be apparent as noise.

Considering that the mass-spring is a resonant oscillator, high mass-spring decay settings will produce a stronger signal at its resonant frequency. Low decay settings, while decaying faster as a system, are more responsive to external modulation. Using lower decay settings will convey more of the noise modulation to the bar.

In the patches you will notice what I have observed about the third order mass-spring system being applied. Oscillations of the subsequent orders are conveyed to the first mass-spring to be applied as a signal. Setting the first frequency as a floor and the second as a ceiling conducts the third order better than a lowest-to-highest scheme.

Trans (for transduction) indicates transmission between mass-spring orders. As the amount of transduction increases, the frequencies spread outwards. The parameter was conceived as a function of the multi-order filter, and is as such abstract. Increased transduction settings suggest a more elastic solid to my imaginings.

This marimba mallet impulse is at 22050 Hz sample resolution.



The position of the mallet is emulated using a comb delay set to the fundamental in combination with the mallet impulse. This produces the same effect on the ideal one dimensional bar as modulating string plucking position - striking the bar in the middle (the highest slider setting) emphasizes the fundamental. Playing position translates energy to the harmonic as a function of ratio. Modulation of timbre by playing position is a fundamental component of mallet technique.

Adding a second set of banded waveguides to materially model the delayed impulse seemed impractical.

resonator

A simple unfiltered delay is used to model the resonators, which are conventionally tuned to the fundamental, located in the center of the bar and so are acoustically coupled with the fundamental. Acoustic vibraphones are modulated by turning discs inside each resonator which open or close the air column, producing a louder signal and shorter decay when resonant.

The idealised and abstracted implementation produces desirable (idealised and abstracted) modulation and musical sustain using artificially applied gain. I have not noticed modulation of the resonator pitch having an overt effect, and most acoustic measurements are within a semitone. The resonator can be detuned by up to three octaves and has a center detent for zero.

The coupling parameter has a range of twice unity gain, the higher region not advised for emulative purpose.

modulation and LFOs

Modulation is routinely applied to three functions in the presets, to playing position, to gain for emulating damping, and to key tracking. Key tracking is applied to amplitude in metallophones and to gain in wooden forms, the first primarily to reduce the volume of artificial high frequency sinusoids (watch your ears?!).

Most parameters are read for each note, for example pitch does not respond continuously to LFOs, which are included here for performance variation.

LFOs may be synced to host rate at 64, 32, 16, 8, 4, 2, 1, 2/3, 1/2, 1/3, 1/4, 1/6, 1/8, 1/12, 1/16, 1/24, 1/32, 1/48 and 1/64 measures.

As a guideline, most amplitude and amount sliders are scaled logarithmically for fine tuning at one extreme, and frequency function sliders are scaled linearly.

pan and amp

The pan control functions as a width parameter when not in mono mode. Widely panned voices (greater than 80%) are softlimited to vary stereo imaging. Using long amp release times with short timbres (eg. xylophones) may produce high cpu, which can be eliminated by keeping release within a few seconds of the audible oscillator decay.

license

Phybes VST may not be redistributed without permission. There is no expression of guarantee due to the use of third-party resources.

Phybes VST is made with SynthEdit - http://www.synthedit.com
© 2009 Rurik Leffanta - All Rights Reserved
http://www.xoxos.net

VST is a trademark of Steinberg Soft und Hardware GmbH