Particle Synthesis

A unified model for granular synthesis

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Overview

Granular synthesis
General characteristics
Specific subtypes (Roads)
Particle synthesis – partikkel (Csound)
All in one generator
New features and new varieties of GS
Interface and applications
General

One single particle (grain) consist of a short sound clip (waveform)

Waveform can be periodic and repeating (synthetic)

...or it can be an excerpt of a recorded sound
Basic parameters

Grain rate
Defines perceived pitch when rate is high (> 20 Hz)

Grain pitch
Defines perceived pitch when rate is low and/or grains are long ( > 50ms)

Grain shape
Attack, decay, sustain, duration

Grain waveform
Varieties of particle synthesis

Previously: separate synthesizers/generators for each type
Main difference: parameter values (available parameter set)
Glissons

Pitch sweep within each grain

Converging
Diverging
Falling
Rising

Separate control of start and end pitch
Frequency masking
Trainlets

Special case of source waveform
Synthetic waveform: band limited pulse train
Base frequency
Number of partials
Chroma, harmonic balance
Pulsars

Pulsaret
Parameter linkage: rate/pitch/duration
Gain masking

‡ Trainlet pulsars
Formant Synthesis

Grain rate constitutes perceived pitch

Grain pitch affects formants

• Partikkel can use 4 separate source waveforms
  - Here: all 4 set to sine wave
  - Separate pitch for each source wave

• Male bass «a» … «e»

<table>
<thead>
<tr>
<th>Pitch</th>
<th>Level</th>
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</thead>
<tbody>
<tr>
<td>600 Hz</td>
<td>0dB</td>
</tr>
<tr>
<td>1040 Hz</td>
<td>-7dB</td>
</tr>
<tr>
<td>2250 Hz</td>
<td>-7dB</td>
</tr>
<tr>
<td>2450 Hz</td>
<td>-9dB</td>
</tr>
<tr>
<td>400 Hz</td>
<td>0dB</td>
</tr>
<tr>
<td>1620 Hz</td>
<td>-12dB</td>
</tr>
<tr>
<td>2400 Hz</td>
<td>-9dB</td>
</tr>
<tr>
<td>2800 Hz</td>
<td>-12dB</td>
</tr>
</tbody>
</table>
Grain clock
Synchronous / asynchronous / modulated

Grain Distribution

¢ External clock input
¢ Partikkelsync, clock output: Phase (ramp) and clock pulse
¢ Frequency Modulation on grain clock
Morphing

Sampled source wave, time modification
Sine
Glisson, converging sweeps
Trainlets
Pulsars
Formants
Asynchronous GS
Waveform mixing
Is it hard to use?

40 parameters per note event
Some parameters are multidimensional
(Grain masking parameters)
Output routing,
mix of waveform sources
++
These are put in tables
Format:
    loop start, loop end, data1, data2, data3, …

…and as if that was not enough
Hadron Particle Synthesizer
Using partikkel and Csound as a DSP core

- Large set of modulators, freely assignable to all partikkel (and modulator) parameters
  - Envelopes, LFOs, Random generators
  - All midi input (note num, velocity, expression controllers)
  - Transfer functions, dividers, modulo
  - Analysis tracks: Transient, Pitch, Amp
- Feedback in modulator signals allowed
- 52 modulators, 209 parameters
Handling a large parameter set

Creates a need for new methods of parameter control
Hadron Particle Synthesizer

Parameter values and modulator routing defined in *states* (presets)

Expression controls for fine tuning

Morphing between states via XY control
Hadron Particle Synthesizer

Csound standalone, Max for Live, VST, AU
DSP library (Csound): LGPL
DSP application (CS orc/sco): LGPL
GUI elements: LGPL
GUI implementation (Juce, Max, M4L): LGPL
Hadron states files (parameter configuration)
Additional states files:
for sale, commercial
Thank you

Hadron at Linux Sound Night tonight