Procedural Sound Design

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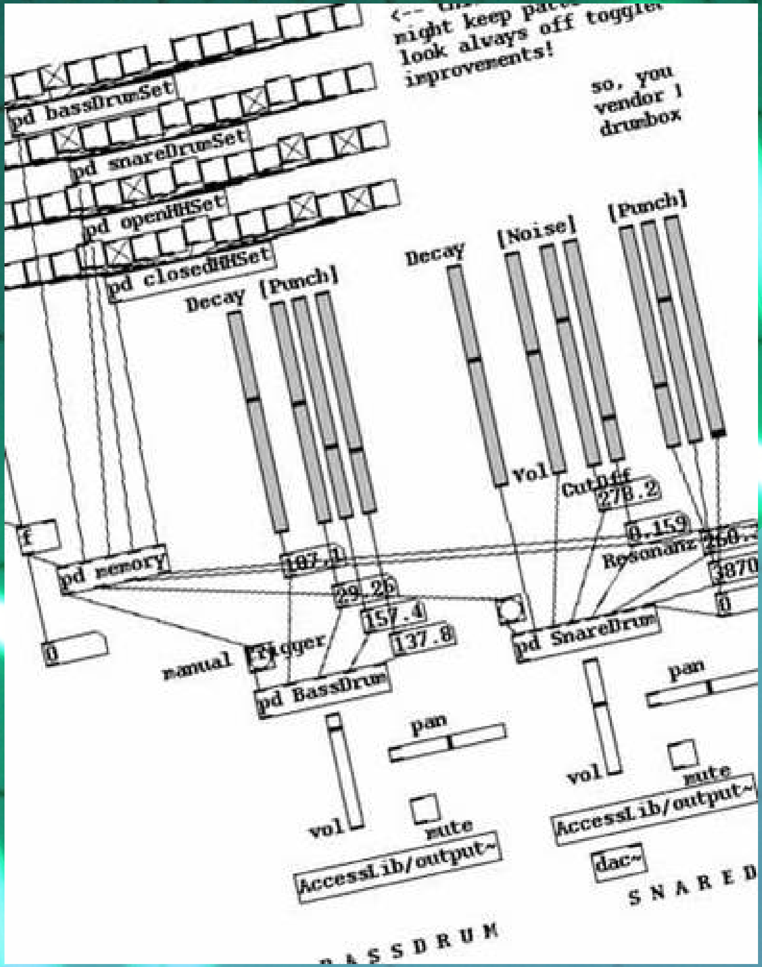
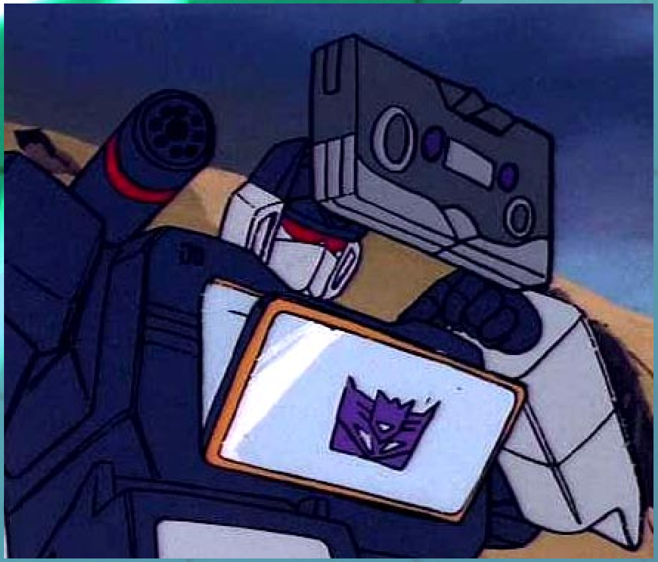


Lyon GDC 2007
Lyon, France

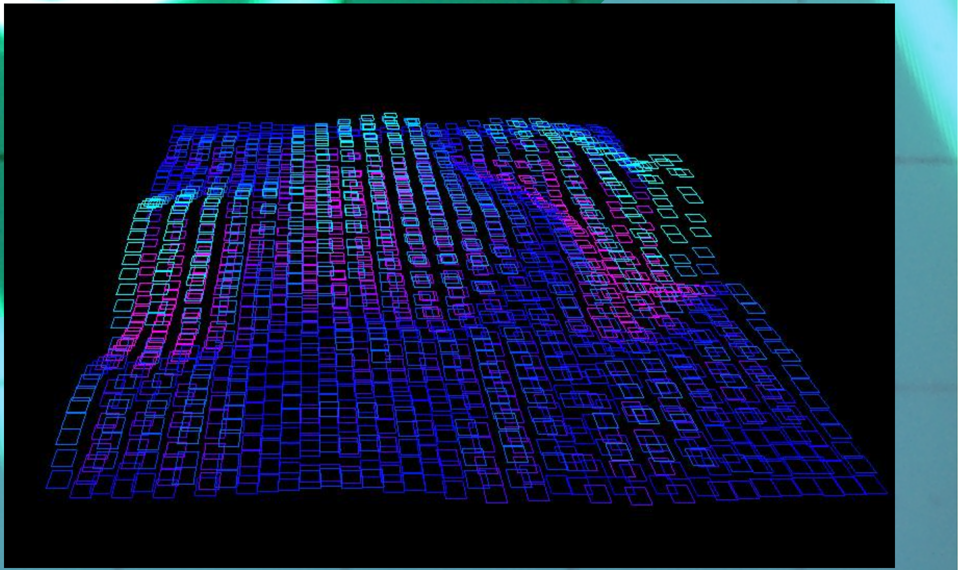
Overview

- Overview of procedural sound design, synthesis & DSP effects
- Newer procedural sound design techniques
- Demonstration
- Questions



Procedural Sound Design

- Generates audio in real-time based on rules
- Has been used in games since the beginning
- Parametric, generative & real-time (ie. flexible)
- Can combine samples with synthesis
- Allow flexibility of layers instead of stereo bounce

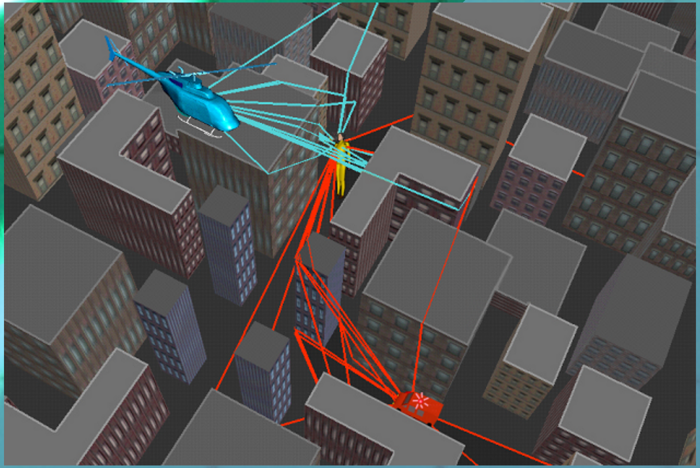


Basic Synthesis & DSP Effects

- Synthesis
  - Additive & Subtractive Synthesis, Frequency Modulation (FM), Multi-sampling synthesis
- Effects
  - Reverb, Delay, Distortion, Filtering, Chorus ...

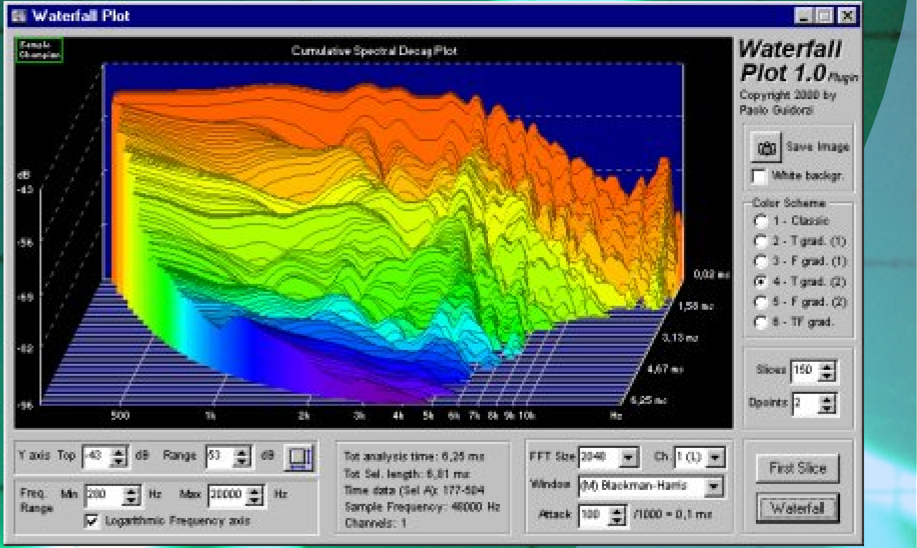
Advanced Synthesis & DSP Effects

- Convolution (IR Reverbs)
- Vocoding and Morphing
- Granulation
- Physical Modelling
- Modal Synthesis
- Concatenative Synthesis



Convolution Reverb

- Model the impulse response of a room
- Can try out impulses with free VST plugin SIR
- Impulses can also be generated by Voxengo IR modeler VST plugin



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Color Scheme
○ 1 - Classic
○ 2 - T grad. (1)
○ 3 - F grad. (1)
● 4 - T grad. (2)
○ 5 - F grad. (2)
○ 6 - TF grad.

Slices 150
Dpoints 2

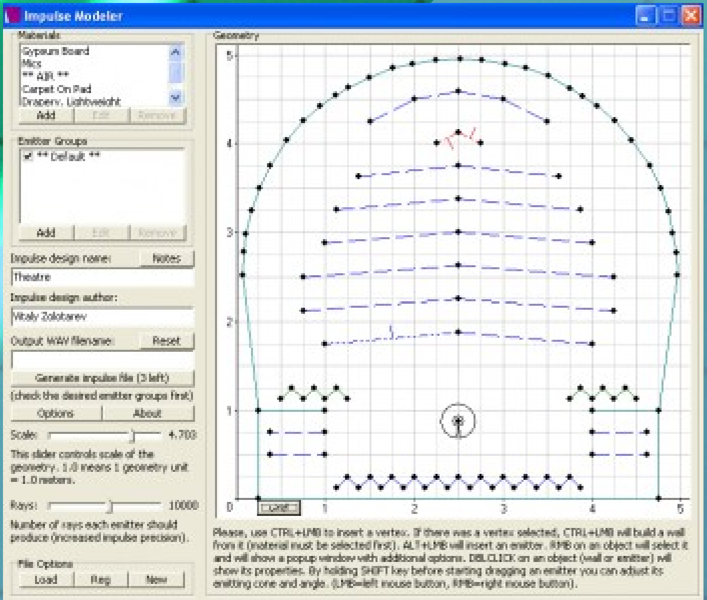
Y axis Top -43 dB Range 53 dB

Freq. Range Min 200 Hz Max 20000 Hz

☑ Logarithmic Frequency axis

Tot analysis time: 6,25 ms
Tot Sel. length: 6,81 ms
Time data (Sel A): 177-504
Sample Frequency: 48000 Hz
Channels: 1

FFT Size 2048 Ch. 1 (L)
Window (M) Blackman-Harris
Attack 100 /1000 = 0,1 ms



Gypsum Board
Mics
** AIR **
Carpet On Pad
Drapery, Lightweight

☑ ** Default **

Impulse design name: Theatre

Impulse design author: Vitaly Zolotarev

Output WAV filename:

(check the desired emitter groups first)

Scale: 4.700

This slider controls scale of the geometry. 1.0 means 1 geometry unit = 1.0 meters.

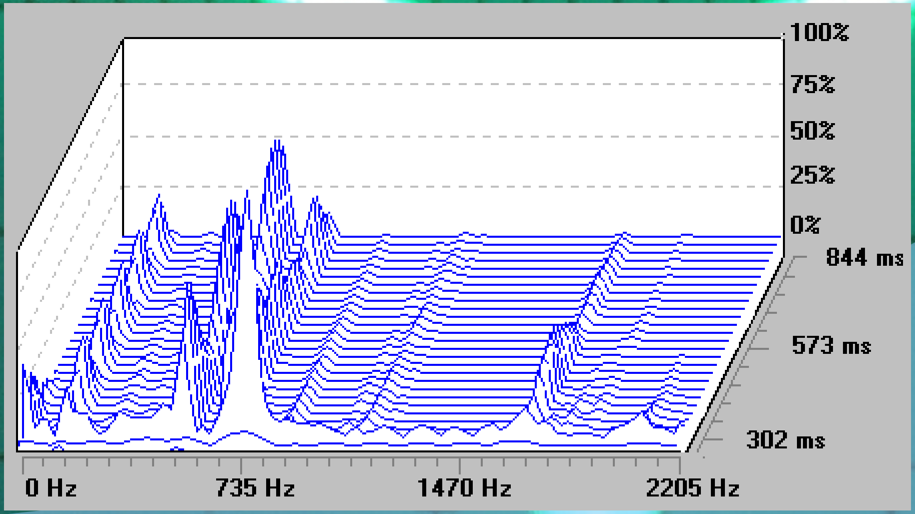
Rays: 10000

Number of rays each emitter should produce (increased impulse precision).

Please, use CTRL+LMB to insert a vertex. If there was a vertex selected, CTRL+LMB will build a wall from it (material must be selected first). ALT+LMB will insert an emitter. RMB on an object will select it and will show a popup window with additional options. DBLCLICK on an object (wall or emitter) will show its properties. By holding SHIFT key before starting dragging an emitter you can adjust its emitting cone and angle. (LMB=left mouse button, RMB=right mouse button).

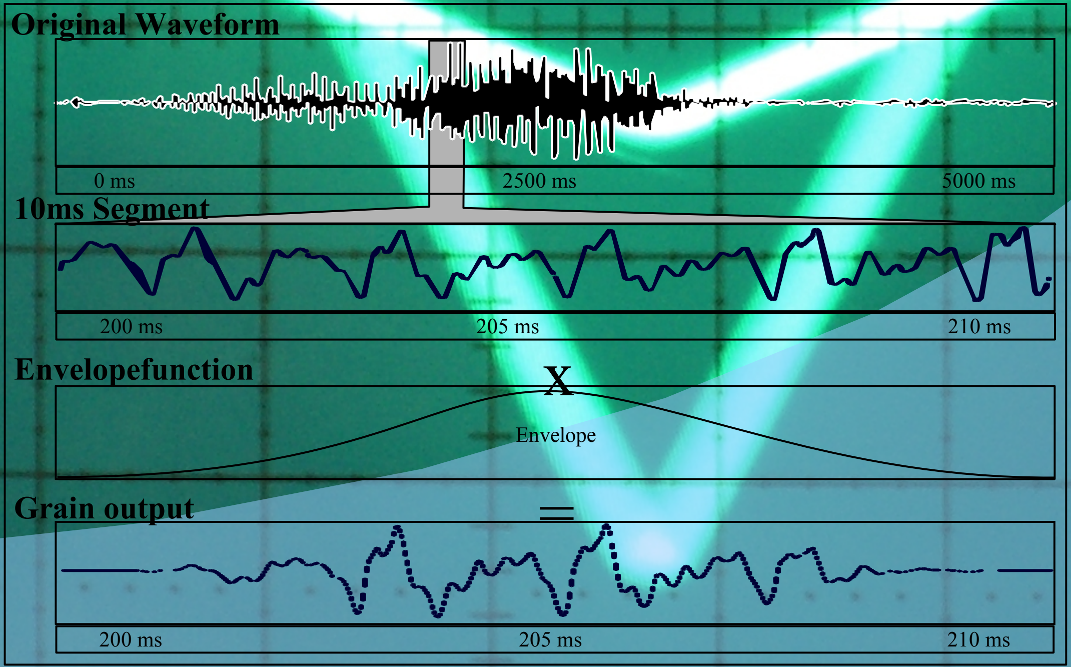
Vocoding and Morphing

- Take the spectral characteristics of one sound and apply them to another
- The idea is to “merge” the two sounds together



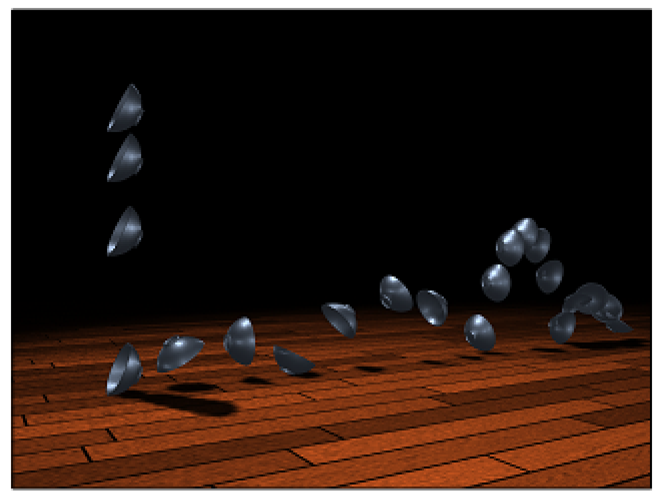
Granulation

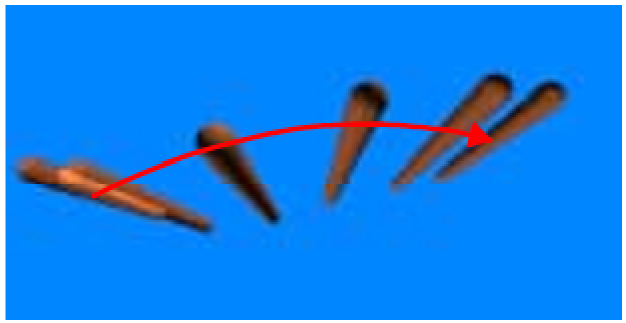
- Split a sampled sound into small “grains”
- Playback of grains allows us independent control of frequency and tempo



Physical Modeling

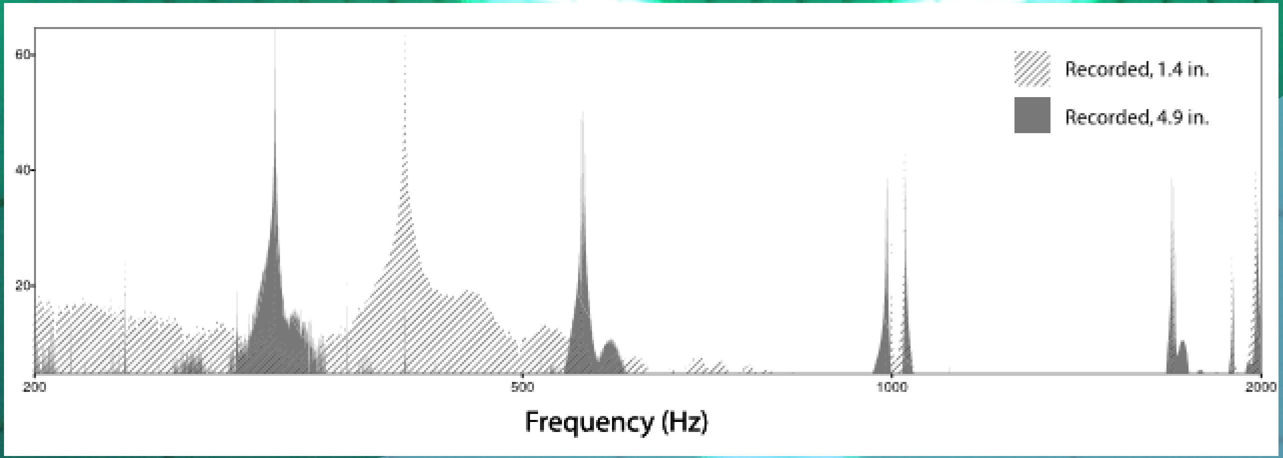
- Mathematically model how a sound is produced and propagates
- Difficult for games as each model is specific
- Good for metal, instruments, swords and more





Modal Synthesis

- Examine the modes or resonances of a material and model them
- Good for wood, plastic and metal impacts



Concatenative Synthesis

- Uses grains of one sound to approximate the original sound, like an “audio mosaic”
- Good for making new textures that are similar

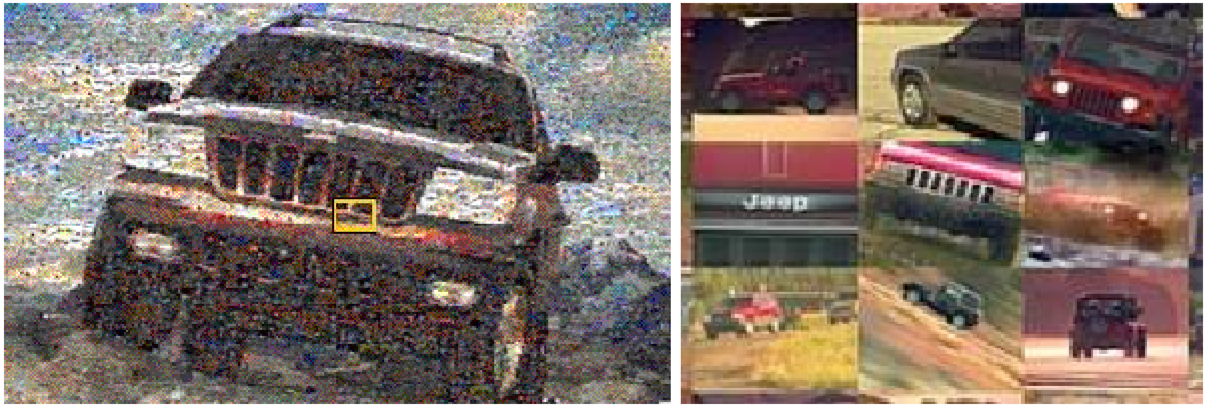


Figure 1: Photo-Mosaic

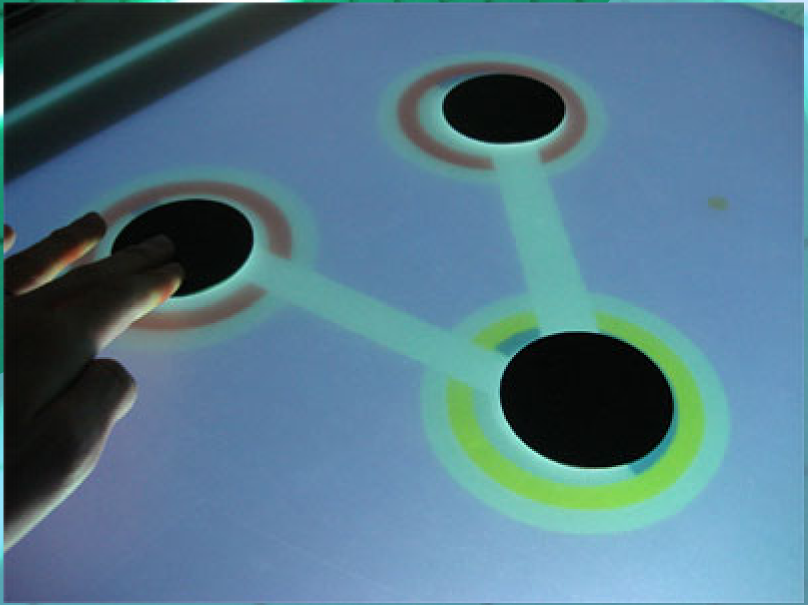
Figure 2: Detail of Figure 1

Using Pure Data (PD)

- Allows for prototyping of audio in real-time
- Relatively easy for audio-folk to understand
- Free-Open Source allows for “code inspiration”
- Active community provides updated versions
- Can communicate with game using Open Sound Control (OSC)

Open Sound Control (OSC)

- Open Source communication between programs
- Like MIDI except over network
- PD supports OSC
- OSC is straightforward to add to game code

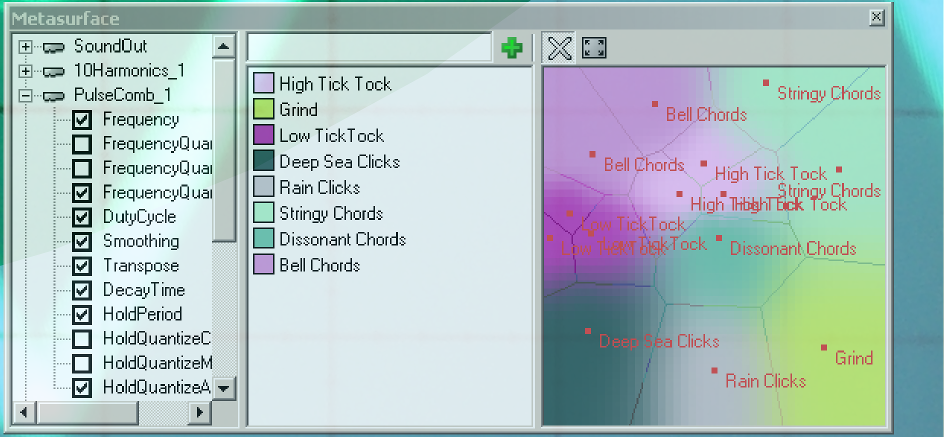


Parameter Modulation

- Complex synthesis methods often require a large amount of parameter modulation
- Granular synthesis requires control over grains
- Morphing between presets:
  - Crossfade (Reaktor)
  - XY plane (Kaos Pad)
  - Metasurface in 'Mulch

Audiomulch

- Metasurface parameter morphing
- Granulation
- VST plugins
- Run PD as a VST inside
- Easy automation control



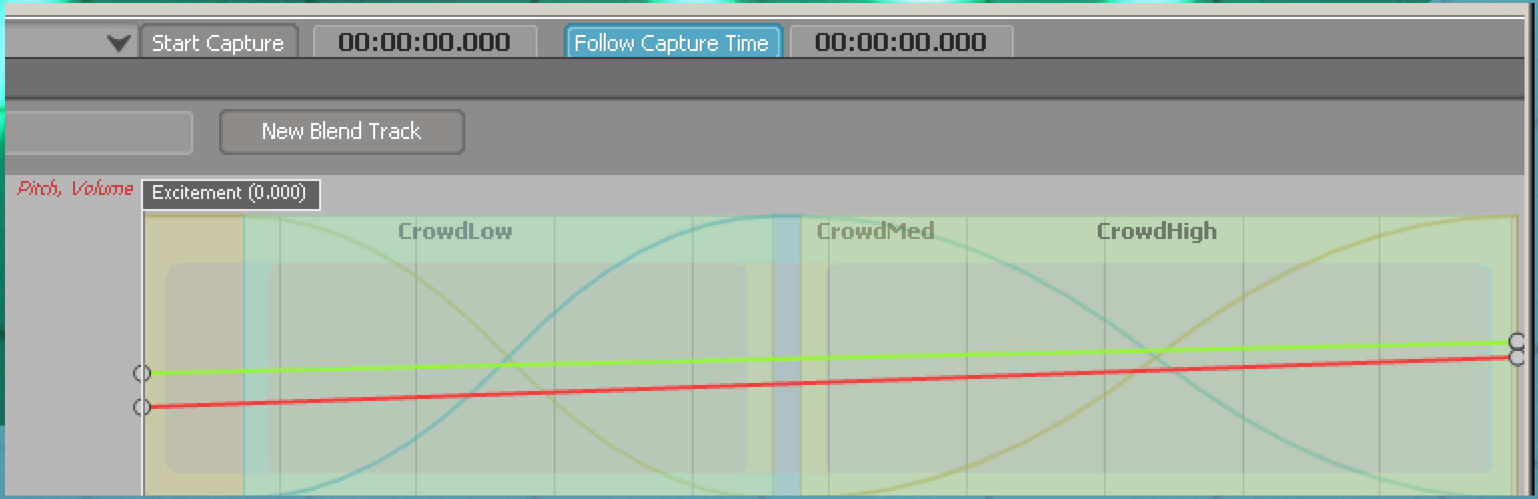
Metasurface

- SoundOut
- 10Harmonics_1
- PulseComb_1
  - ☑ Frequency
  - ☐ FrequencyQuai
  - ☐ FrequencyQuai
  - ☑ FrequencyQuai
  - ☑ DutyCycle
  - ☑ Smoothing
  - ☑ Transpose
  - ☑ DecayTime
  - ☑ HoldPeriod
  - ☐ HoldQuantizeC
  - ☐ HoldQuantizeM
  - ☑ HoldQuantizeA

- High Tick Tock
- Grind
- Low TickTock
- Deep Sea Clicks
- Rain Clicks
- Stringy Chords
- Dissonant Chords
- Bell Chords

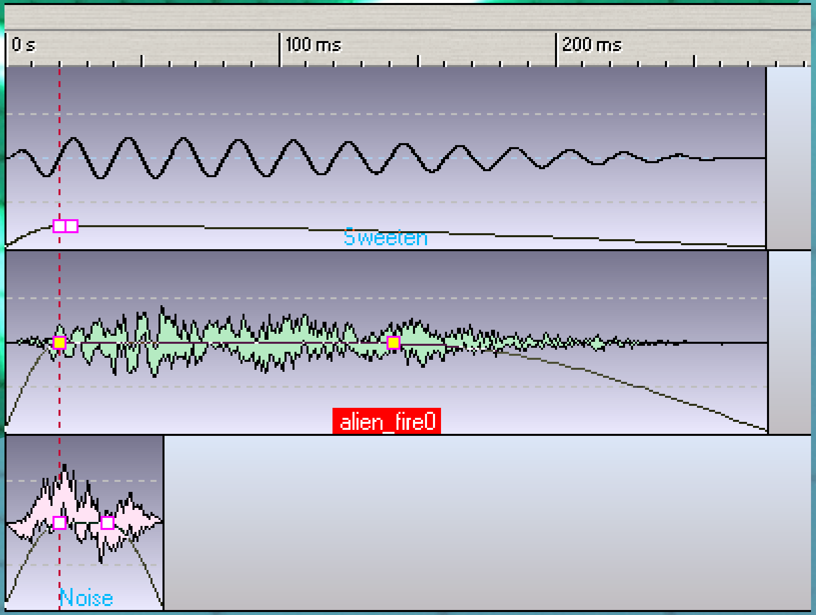
Audiokinetic Wwise

- Procedural audio can be done by randomizing layers and effects
- Easy, yet flexible control structure parameters
- Blend containers:



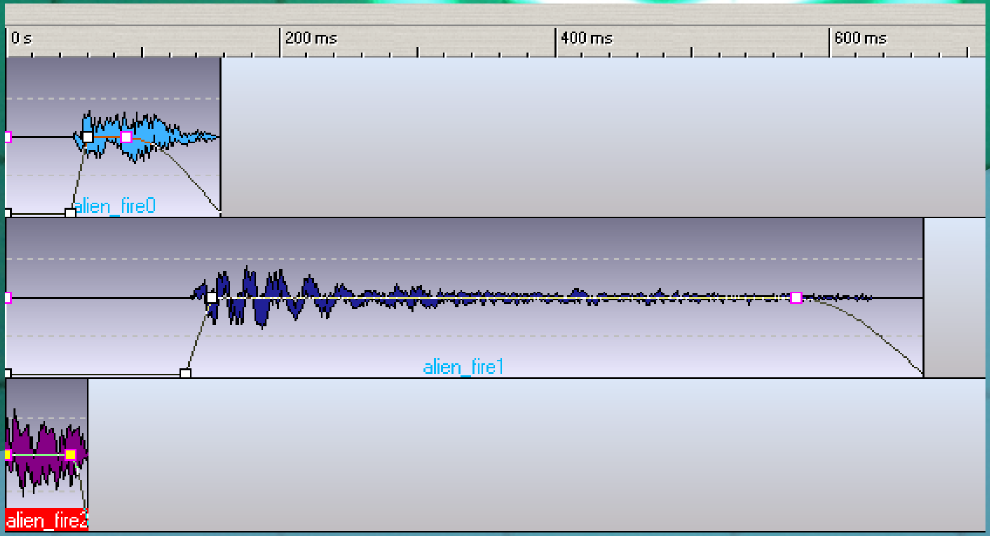
Horizontal Layering

- Take components of sound and layer them to allow individual control over elements
- Good use would be a physical model for a low-end sweetener



Vertical Layering

- Primarily sequencing between versions of a sound effect to create variation
- Can also be used with loops, almost like a pool of large grains for granulation



Demonstration

References

- Perry Cook - http://www.cs.princeton.edu/~prc/
- Curtis Roads - http://clang.mat.ucsb.edu
- Andy Farnell - http://obiwannabe.co.uk
- http://www.procedural-audio.com

Questions ?

Info { at } VideoGameAudio.com

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