Procedural Sound Design

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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
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
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
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
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