Granular Synthesis in Next-Generation Games

Game Developer's Conference
March 2006
San Jose

Leonard J. Paul
Vancouver Film School
Game Audio Instructor

lpaul {at} vfs.com
604-685-5808 x4035
Grain Production

Original Waveform

10ms Segment

Envelope function

Grain output

Source Granular Grain Game Developers Conference
Granular Synthesis Flowchart

Grain Voice 1
Grain envelope
ENV
OSC
Amp
1/dur
Freq
Grain Waveform
OSC

Grain Voice n

Multi-channel Output
Granular Density Spectrogram
Granular Parameters

1) Selection order (forwards/reverse or freeze)
2) Pitch shift (playback rate)
3) Amplitude range
4) Spatialization / panning (static/dynamic)
5) Grain duration
6) Grain density (number of grains/second or number of grain voices)
7) Envelope (ASR shape, attack/release slope or windowing function)
8) DSP effect (reverb, filtering etc.)
9) Feedback amount (for granular delay lines)
Grain Segmentation

Split into natural length sizes similar to syllables to improve granulation

Source  No Segmentation  With Segmentation
Dialogue

- Independent control over pitch and tempo
- Segmentation
- Phase vocoder
- Examples

Source  Pitch and tempo variations
Sound Effects

- Delay-line granulation effect
- Synthesis techniques
- Scraping, skidding and sliding
- Ambiances
- Examples
Crowd Engines

- Granular cross-fading / morphing
- Crowd intensities
- Chaining between chunks
- Reduction of identifiable loop elements
- Examples
Car Engines

- Segmentation
- Layering
- RPM bands
- Pitch-shifting
- Examples

Source
Music

- Techniques and aesthetics
- Real-time vs. pre-rendered
- Grain quantization
- Software tools
- Examples

- The Corporation
- Granular Impulse
Granular Effects

- Techniques
- Delay-line granulation
- Granular reverb
- Examples
Granular Surround

- History of use of diffusion in performance
- Grain speaker assignment
- Trajectories
- Examples
Granular Particle Effects Control Parameters

Particle Physics Parameters: vel, pos, etc..

Granular Synthesis
Granular Software

Malström

KTGranulator by Koen Tanghe for Smartelectronix
CloudGenerator for Mac

Curtis Roads & John Alexander 1996
Granular Footsteps in Java

Chirag Mehta
Natural Wavelet Grain Segmentation in Java

Reynald Hoskinson
Synthesis Toolkit

Perry R. Cook & Gary P. Scavone
AudioMulch

Ross Bencina
Max/MSP Granular Synthesis

msp Granular Synthesis

nobuyasu sakodna / July 2000
sako@marin.or.jp

random panning
narrow wide

load new sample
replace replace tongue.aff

buffer. playobject
chiko.aff -1
s buffer.out
window shape
buffer. wndw. sine
sine
prepend replace

buffer.out
expr $t2 - $t1
s raw_length
s sample_length

loadbang
1

receive. Rout
receive. Rout

noise
0.
0.0125
0.025
0.25
0.375
0.5
0.625
0.75
0.875
grain2.5
grain2.5
grain2.5
grain2.5
grain2.5
grain2.5
grain2.5
grain2.5
grain2.5
grain2.5
grain2.5
grain2.5
grain2.5
grain2.5
grain2.5
grain2.5
grain2.5
grain2.5
grain2.5

0.25
0.5
0.75
0.875

output gain
0.4
0.25

auto sequencing
manual control
playback control

Control mode
auto sequence
+ 1
p seq_engine

playback speed

move slider or drag on buffer window

r buffer.out
p slider_adjuster

play position in sample (ms)
1020.628296

position randomness
5.

expr 1000. / \$11 \* \$12

v2.5

Game Developers Conference
Pure Data Granular Synthesis

syncgrain~
~~~~~~~~~~
a synchronous granular synthesis object by frank barknecht

set arrayname

GrainFreq Amplitude Pitch Size PosRate

dac~
Implementation

- Prototyping
- Integration into game audio tools and libraries
- Pure Data demos and prototyping techniques
- Source code examples
Granular Software

AudioMulch
Fruity Loops
Ableton Live
KTGranulator VST Plugin
Propellerhead's Reason
CloudGenerator
Granular Footfall Synthesis
Natural Wavelet Segmentation
Synthesis Toolkit (STK)
Max/MSP
Pure Data

http://audiomulch.com/
http://www.flstudio.com/
http://www.ableton.com/
http://www.koen.smartelectronix.com/
http://www.propellerheads.se/
ftp://ftp.create.ucsb.edu/pub/CloudGenerator
http://chir.ag/493/FootFallDriver.html
http://www.cs.ubc.ca/~reynald/naturalgrains.html
http://ccrma.stanford.edu/software/stk/
http://www.cycling74.com/
http://www-crca.ucsd.edu/~msp/software.html
Granular Source Code

Nick Fell's Grantab for Pure Data  
http://www.gla.ac.uk/music/studio/spiclem.html

Ross Bencina's Implementation of Granular Synthesis  
http://www.audiomulch.com/~rossb/

Frank Barknecht's Pure Data Port of SyncGrain  
http://footils.org/cms/pms/

SyncGrain SndObj Library by Victor Lazzarini  
http://music.nuim.ie/musictec/SndObj/main.html

Amber  
http://www.euph0r1a.net/projects/?handler=amber
Questions?

lpaul {at} vfs.com

http://www.VideoGameAudio.com