Assignment 3
Granular Synthesis and PureData

COSC 4P98 - Computer Media and Digital Audio

Brock University

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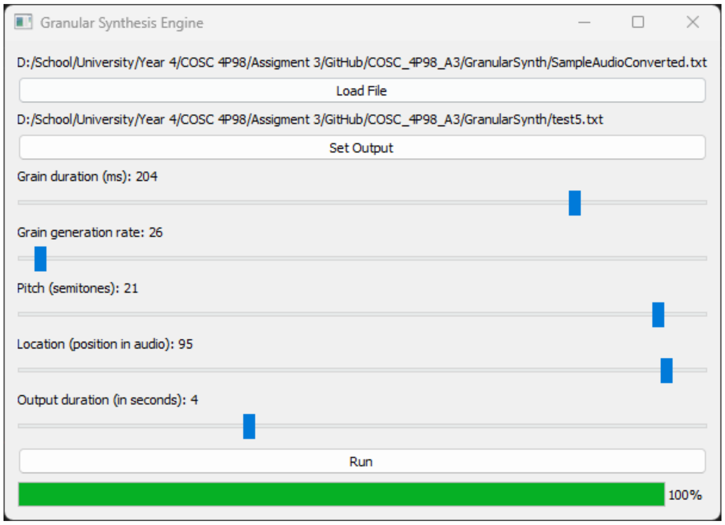
1. Granular Synthesis Engine

Requirements & Usage

The Python libraries used in the granular synthesis engine are:

- tdqm (for progress bar)
- PyQt5 (for GUI)



D:/School/University/Year 4/COSC 4P98/Assigment 3/GitHub/COSC_4P98_A3/GranularSynth/SampleAudioConverted.txt

D:/School/University/Year 4/COSC 4P98/Assigment 3/GitHub/COSC_4P98_A3/GranularSynth/test5.txt

Grain duration (ms): 204

Grain generation rate: 26

Pitch (semitones): 21

Location (position in audio): 95

Output duration (in seconds): 4

How to Run - GUI

To run the granular synthesizer, run the GUI through a terminal command `python GranularSynthGUI.py`. Next, load a file, modify the sliders in the GUI, set an output file, and hit ‘Run’ to perform granular synthesis on the audio with your desired parameters.

How to Run - Command Line

The program also runs in the command line with arguments. The arguments are as follows:

```
python 'inputFile.txt' 'outputFile.txt' sampleRate grainLength(ms)
grainDensity(grains/sec) pitch location(%) duration(sec)
```

Ex.

```
python .\GranularSynth.py 'SampleAudioConverted.txt' 'test.txt' 44100 100
200 -12 .8 2
```

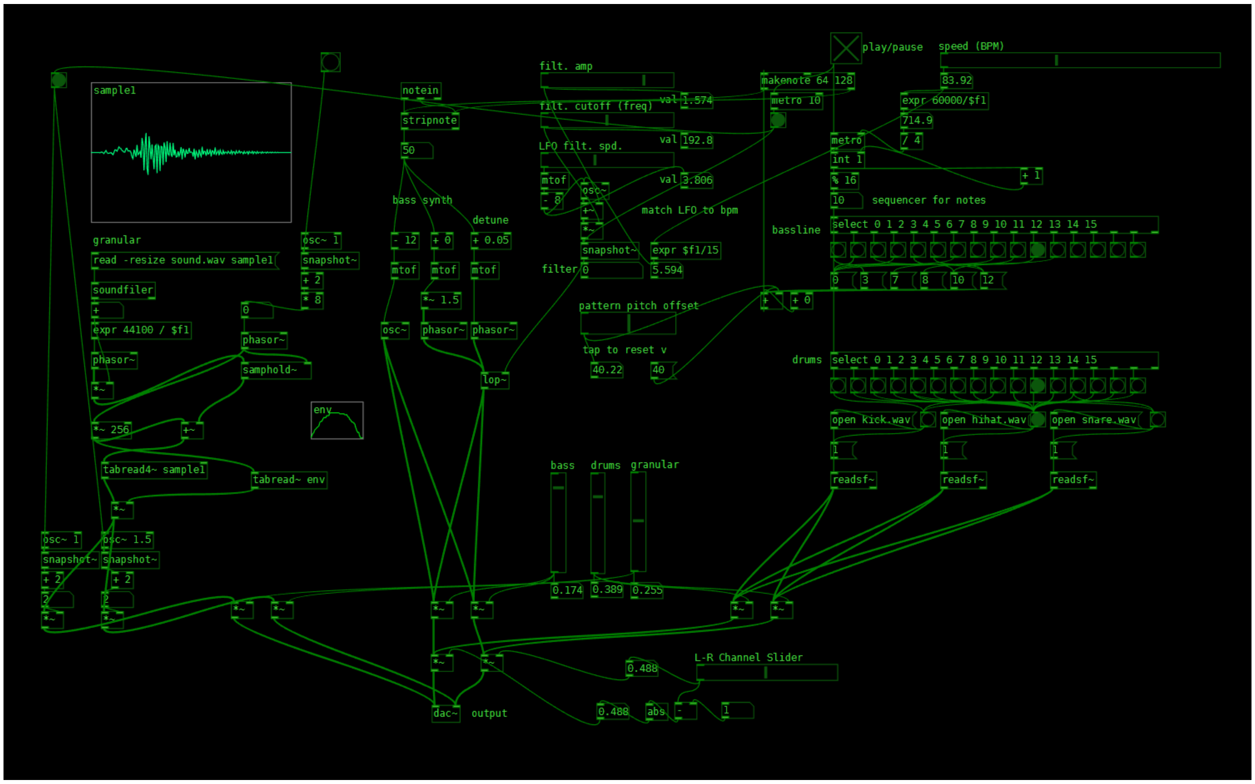
The granular synthesis engine does not change between the GUI and the command line versions.

Features

The granular synthesis engine accepts the arguments to control features of the synthesis engine.

- `SampleRate` controls the sample rate of the output file.
- `grainDensity` controls the number of grains to be produced in a second. The higher the grain density the greater likelihood a grain will be created at a sample.
- `pitch` controls the pitch that the grain will be pitched to. The pitch is in 1/12 step sizes, where 12 would produce 1 octave pitch higher.
- `Location` controls the percentage of the input file to be used in the granular synthesis. The percentage is distributed evenly from the center of the file. Ex. if .8 is inputted, the first and last 10 percent of the input fill will not be used in grain composition.
- `Duration` controls the length in seconds of the output file.

2. PureData Composition



This is what the project looks like in PurrData

▶️ Here is a live recording of the composition on YouTube.

Requirements & Usage

The project was created using PurrData, an improved version of PureData with a few extra features such as themes. It will run in all versions of PD.

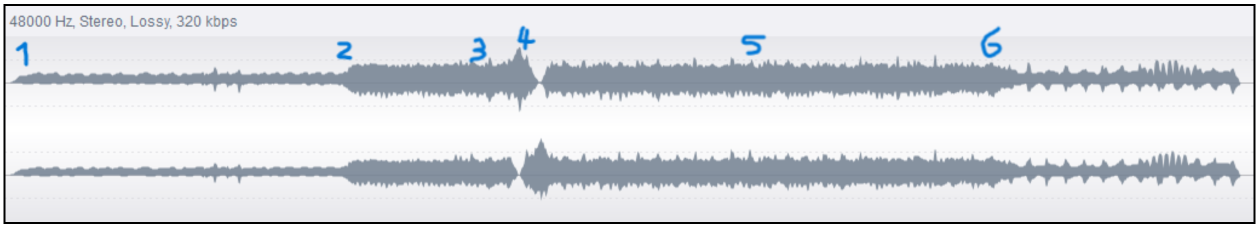
To open the file, open PureData and locate 'pd_composition.pd'. Some of the sliders and messages may need to be initiated:

- 'read -resize sound.wav sample1' must be clicked (under sample1 window)
- The 0 underneath the L-R channel slider must be set to 1
- All of the sliders need to be clicked on/modified to activate

Composition Structure

Here is a rough breakdown of the structure of this composition:

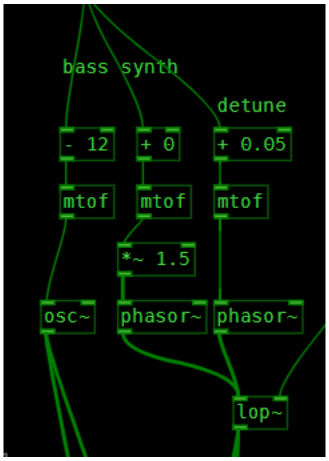
1. 0:00 to 1:12 is the intro to the song, with only the bass synth fading in.
2. At 1:13, the LFO controlling the filter cutoff syncs to the BPM as it increases. The drum machine is then brought in and plays a 4/4 drum, hi-hat and snare pattern. Some parameters, like the filter amplitude, are modified on the fly during the recording to keep it from getting stale.
3. At 1:50 the granular pitch shifter is introduced bringing a very experimental sound into the mix.
4. At 2:05, the L-R channel slider is changed to pan the sound from left to right, this is also used at 4:40.
5. At 3:05, the pitch of the granular pitch shifter is changed manually instead of being controlled by an LFO.
6. From 4:08 onwards is the outro in which the drums are silenced and the instruments fade out.

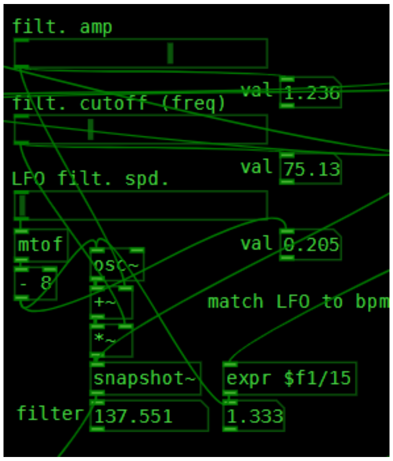


Waveform of the composition.

Instruments

Bass Synthesizer





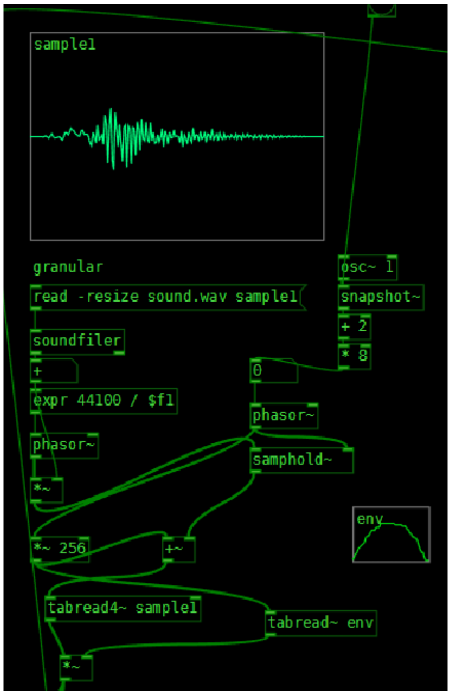
The bass synthesizer instrument consists of 3 oscillators: one shifted -12 semitones, and two sawtooth waves in which one is detuned by +0.05 semitones, creating a neat ‘moving’ effect.

It is then run through a low-pass filter that is controlled by an oscillator. The oscillator frequency can be controlled manually (LFO filt. spd.) or can automatically be controlled by the BPM, in which it will oscillate every 1/4 note.

Granular Pitch-Shifter

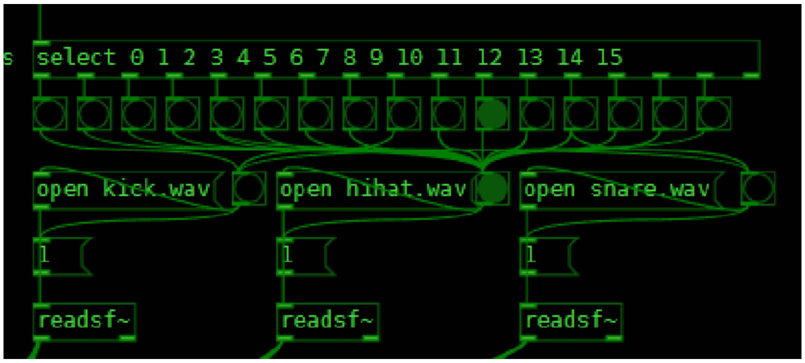
The granular synthesizer performs granular pitch shifting on an input file ‘sound.wav’ which is the ‘Role Reveal’ sound effect from the game *Among Us.*

It splits the input file into grains of size 256 samples, and plays it back at a rate that is controlled manually or by an LFO. There is a Hanning envelope that controls the amplitude of each grain, preventing any clicking sounds from sliced grains. This can be drawn in the array editor.



Drum Machine

The drum machine uses a kick drum sample ‘kick.wav’, a hi-hat sample ‘hihat.wav’, and a snare drum sample ‘snare.wav’. The kick drum and hi-hat sound effect comes in one of FL Studio 20’s built in sample packs. The snare is from the Roland TR-707 Drum Machine.



The sequencer works by incrementing a counter and performing a modulus operation to loop the pattern. The pattern is set by connecting the ‘bang’ triggers to the position in the incrementing sequencer.