COMPUTER MUSIC PERFORMANCE IN REAL-TIME BY GRANULAR SYNTHESIS IMPLEMENTED WITH WAVELET TRANSFORM IN PD

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Aesthetic Purpose

My aim is to create a musical piece where looking for new textures and organic sounds by means of granular synthesis. I have chosen granular synthesis because of I want to create small creaking sounds (like in click & cuts or minimal electronic music) and big statical masses of sound with thousands of small variations inside (like in some pieces of Ligeti or Xenakis). Granular synthesis allow to create this different sounds in a single way and I can go from one of this isolated small grains to a dense textures traveling across a lot of intermediate states.

Structure of Composition

The structure of the composition is based on construction and deconstruction of a 'sound scene' (a group of samples related themselves in a semantic point of view that describe an only situation, idea or sensation). This 'sound scene' is formed with different samples and this samples with a lot of grains. So, I can broke up the 'sound scene' in different musical levels and to play with the interrelation of them.
The composition start with very small isolated grains creating rhythms based on the inner rhythm of the sample which grains belongs to. More grains that belongs to another samples are added and the composition increase its density. Now we can start to recognized the samples used and they are presented modified in different ways. Then, the 'sound scene' is created and presented once samples are recognized and put together. At this time, construction process has been done and 'sound scene' has been presented.
Until now, the composition was playing with different semantics levels and relationships for present the sound scene, and at the same time, composition was increasing in sound density and complexity. That was a process of construction.
Now, 'sound scene' is modify in different ways, cut, reconstructed, and multiplied to reach a big mass of sound where 'sound scene' is lost inside. This statical mass of sound progress slowly, increasing its density with an inner structure analog to inner structure of 'sound scene'. This similarities between different levels allow to give unity to composition. Composition finishes when sound mass reach the widest frequency spectrum and highest density, with a behavior like noise. That was a process of deconstruction.

Motivation and Theoretical Base

This composition is motivated by ideas related with the role of modern man in actual society and the influence of mass media and globalization. It is related with idea of accumulation of information in modern society and incapacity of assimilate huge amounts of information generated by machines too.

Modern man, like grains at the beginning of composition, is isolated but immerse in a huge society full of microscopical movements but statical in its structure, like big mass of sound at the end of composition. So, that growth of density in composition is related with the growth of information density in modern society and its tendency to reach a chaotic state.

This tendency to chaos in modern society is very interesting in musical terms and, like in chaotic systems, I use symmetries between different scale levels to unify material in composition.

At the same time I'm specially interested in research on semantic structures and relationships between different semantic levels (like in some pieces of Berio).

All of that is not a justification for composition, it is only underlying concepts that allows me to organized sound structures and materials to be based on human and natural structures that happens in modern times.

Technical Purpose

My aim in technical terms is allow to develop that aesthetic and musical concepts in a effective way. Technical requirements never have to be a justification for itself, so they have to be subordinated to musical purpose.

For this reasons I selected granular synthesis by means of Wavelet Transform resynthesis as method to built the composition.

Granular synthesis is based on ideas of Dennis Gabor about decomposition of sound in thousand of microscopical grains that contains time-frequency information. In the same way, Wavelet Transform (like Short Time Fourier Transform - STFT) allow an analysis/resynthesis of sound signal in time-frequency domain. The sound reconstruction is possible by add of different Wavelets (as grains in granular synthesis). So, sound can be modify between analysis and resynthesis steps by wavelet coefficients modifications. Wavelet Transform is chosen instead of STFT because of the first one allow a multiresolution analysis closer to human perception than STFT. Wavelet Transform allow a good implementation of time stretch and pitch shift, transformation between different timbres (cross synthesis), and dynamic changes in spectrum.

Discrete Wavelet Transform (DWT) can be implemented by means of a filter bank (chains of lowpass and highpass filters) and I thing Pure Data (PD) can be a good tool for this implementation.

Grain streams can be implemented by excited wavelets with an impulse train. Modifying frequency of impulse train we can modify gap between grains and therefore density of sound. Controlling impulse trains I can control number of grain streams (and density) and phase between streams (synchronous or asynchronous granular synthesis).

Combination of Wavelet Transform and granular synthesis allows to modify samples of 'sound scene' in such a way that I can make a sample more or less recognized and play with semantic levels.

Methodology

This is the diagram of implementation in PD for tis composition:

- 1. Analysis with Discrete Wavelet Transform (DWT) of samples to use. This is made not in real-time. We obtain a matrix of coefficients for each sample. Implementation of DWT is made by means of a filter bank.

- 2. Patch to control amplitude of coefficients in wavelet matrix for each sample. Made it to control in real-time.

- 3. Patch to control time stretch and pitch shift of each sample. Made it to control in real-time.

- 4. Patch to control wavelet resynthesis in a granular way by means of impulse

trains that excited selected wavelet (density, frequency, similarity to original sample...). Made it to control in real-time.

- 5. Environment to trigger grain stream in real-time by means of MIDI controllers.

Future Research

My future purpose to make progress this project is:

- To obtain specific information about how to implement Discrete Wavelet Transform (DWT) by mens of filter bank in PD, and make this implementation for DWT analysis of sound samples.

- To research possibilities of modify wavelet coefficients matrix for a later resynthesis in a granular way.

- To design an implementation of granular synthesis from DWT. Implement a patch to control granular synthesis parameters.

- To design a personal musical interface to control different parameters during performance of composition in real-time.

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