Framulator

The Early Stages of an Audiovisual Granular Synthesizer

Luca Serafini

ArtScience B1

05/06/2020

The Tool

Granular Synthesis – a small introduction

Granular Synthesis is a technique in sound composition in which an audio track can be segmented in small parts called grains. Each of these grains, multiplied by envelopes and LFOs can then be rearranged in a timeline to form clouds and textural sounds.

The method was first suggested by Iannis Xenakis (Roads 169), which took an approach similar to quantum physics in trying to find indivisible parts (quanta) of sound and resynthesize them into a new piece (Xenakis, and Kanach 43).

Here the approach is adapted in its audiovisual realm to a video file. By defining the visual quanta of the video as the frame, one can rearrange, multiply, and sequence patterns, to synthesize new contexts in moving sound-image. The process can be achieved with Non-Linear Editing software with the expense of time and arduous "manual" work, but in this project, it is automated via algorithmic tools, in order to not only achieve complex designs but to use Stochastics, in other words, a probabilistic rather than a deterministic distribution of chances to compose visual frames into a video file.

Panorama

Although analog circuitry holds fast, realtime processing, it lacks in memory storage, compared to digital solutions. The first digital frame buffers came in the mid-70s, but the high cost of the technology called for DIY options for artists. Research conducted at the Experimental Television Center in upstate New York led to the creation of the Jones Frame Buffer, the first notable video tool for digital recording and processing of a video image. An analog to digital converter (ADC) would quantize an image in shades of grey, feed it to recycled digital memory chips, which in turn led back to a digital to analog converter (DAC), restoring the data back to analog video and giving birth to a sophisticated video instrument that could capture and hold a single frame or part of a frame. It can be seen in action in *Camel with Window Memory*, by Peer Bode (1983). The next step, the final version of the Jones Frame Buffer, made by Dave Jones, could store 16 frames in a 256x256 line resolution, and play it back to recreate motion (High et al. 531-549).

Although it could not reorder the sequence by which the frames were outputted, the Jones Frame Buffer demonstrates a core philosophy that could later permit video grains. It was not until the late 90s that a computer could control and process video in real-time without a significant drop in framerate and/or resolution.

With the evolution of processing power in digital computers, it became possible to analyze audio and video files and perform a re-synthesis, in other words, divide the stream of information in “indivisible” quanta and reorganize them to create something with new properties. In this section, I present notable examples of audiovisual granular tools created by artists/researchers.

-**VARP9**

This software is the oldest attempt in automating the process of an audiovisual granular synth. It was developed by Ulf Langheinrich and Kurt Hentschlaeger from the art collective Granular Synthesis, with the help of Dirk Langheinrich. VARP9, developed between 1996-1999, was a natural evolution from their previous experiments in performing granular composition with editing software and audio sampling (Langheinrich, and Hentschlaeger). The software is proprietary, and it works by dynamically sampling audio and video into a computer RAM, which allowed the user to perform switches between different source videos and perform granular operations on them, mixing and selecting grains from two sources at a time. All the parameters and triggers are controllable with MIDI messages.

-**Kortex**

Kortex is an ongoing research project from Joshua Batty, an Australian musician, visual artist, and creative coder. The software targets mostly AVJs (audiovisual jockeys), was prototyped in openFrameworks and Max/MSP, is precise up to the frame level, with dynamic access to prepared videos up to 40s and performs at 60fps. Besides successfully performing audiovisual granular synthesis, Batty's research attempts to map synesthetic relationships between image and sound grains following arbitrary conventions, at micro and macro levels. For instance, downsampling the audio track leads to visual pixelation; a change in amplitude of sonic grains performs an overall change on the contrast of the same frame-grain, among other pre-established effects (Batty et al.).

-**Forbes/Villegas' Untitled Granular Software**

Forbes and Villegas hold the most sophisticated research, as they take the concept of the image-grain further, up to the pixel or a windowed set of pixels. They approach video as a parallelepiped comprising of pixels and frames. After setting window sizes and applying smoothing envelopes to the grain, they can be digitally processed for effects, repositioned, and rotated in the 3d video structure. Therefore, the output work can be extremely deformed since each instant can be composed of grains from other frames, resembling slit-scan like filters (Forbes, and Villegas).

How it works

The Framulator, in its version 1.0, works by connecting two programs, Processing and Supercollider. The former is a Java-based framework for algorithmic composition for the visual arts and the latter a Haskell-based programming language for real-time sound synthesis.

The Processing code functions as a frame buffer, whereas the supercollider code acts as an audio buffer and a frame sequencer.

Processing-side

The input video (.mp4, .mov or .mpeg) is preloaded and stored frame by frame in a linked list structure. After loading the whole file, the code sits idle listening to MIDI messages. Since MIDI pitches range from 0-127 values, the frame buffer also listens to MIDI channel messages that range from 0-16. This allows for the buffer to separate 'chunks' of video composing of 128 frames. When the program catches an incoming message, it gets further mapped to a valid frame in the buffer, rapidly drawn to the screen.

Supercollider-side

Audio, manually split by the user (.mp3, mono), is preloaded into a buffer by the Supercollider code. With the use of the extensive Pattern class, MIDI messages are sequenced in any given way by the user to re-synthesize audio (by sweeping through the buffer array in the Supercollider server) and video (by re-ordering the frames in the linked list created by the Processing program).

Stochastic/Re-Synthesis

With the use of the Supercollider Pattern class, the Framulator enables the user to not only create different series of frames with offsets and switching, thus generating a deterministic behavior but to also apply Stochastic patterns, such as *Pbrown*, *Pwhite* and *Pwalk* to compose frames, generating more complex sequences subject to a range of probabilities.

Further Improvements

The Framulator is far from its final version. As for a prototype, the current application is working to a standard that it performs audiovisual Granular Synthesis to the frame level. Its constraints and limitations are not yet fully tested and seen as a flaw but rather a set of characteristics that conditions the output files.

Improvements on next versions should be developed for real-time performance scenarios, such as shifting the communication protocol between Processing and Supercollider to OSC (Open Sound Control) for better performance and the possibility of leaving the MIDI channel for physical controllers and adding live feed video capture; implementing a user-friendly interface with the automation of audio/video splitting stages, reducing the amount of “manual” preparing work and further enhancement of sound quality and sync-ing issues.

For any of these improvements to be made, the Framulator should be developed in a more robust and fast language, such as openFrameworks. Considering its implementation in C++, it provides low-level fast access to computer memory, making the overall process optimal. Therefore the Supercollider code would run free to only sequence OSC messages to the audio and frame buffer.

-Breaking the Program

A couple of known bugs provide interesting unexpected results. Since the frame buffer does not check whether the audio is sourced from the video, it produces an anti-synesthetic effect and syncing errors. Another flaw happens when the same Supercollider code is evaluated multiple times as long as the server-side can handles it. In this case, it means that the MIDI sequencer sends multiple messages roughly at the same time, resulting in unexpected in/out of phase patterns, sometimes resembling canon compositions.

The output

Following the output experiments from the Framulator, which are available within the provided folder of this project, a comparison with some notable past artworks arise. Although the technical approach can be similar, and a clear inspiration is borrowed from these artists, I argue that this research project deviates in form and concept from the examples below.

-**Raphael Montañez Ortiz *The Kiss***

The Kiss (1985), is a reconstruction of narrative portrayed in typical Hollywood movies. By digitizing film into a non-linear editing desk and manipulating frames, Ortiz, which came from a long career on Destructivist works, transforms a short cliché kiss scene in an aggressive 6-minute long ritual of audiovisual punching. The act amplifies sexual tension and subverts Hollywoodian formulas and conventions of heterosexual romance (Noriega 36-40).

-**Granular Synthesis Modell 5**

Although this work from Ulf Langheinrich and Kurt Hentschlaeger (Granular Synthesis), precedes their proprietary software VARP9, the final format of the piece performs audiovisual granular synthesis with the help of a Non-Linear editor. From a short footage of performer Akemi Takeya, expressions are torn into segmented intensities and their recombination and almost perpetual repetition concern an influence on the audience’s perception of the present, by offering a machinic like character, trapped in time and pain (Scheer 115-122).

This unearthly experience of time is specifically what is felt with the output experiments from the Framulator. However, instead of amplifying the present NOW, the conceptualization of the work takes a different turn here, which is discussed in the next sections.

Concept

There are two different ways to describe the order of events and their relationship with time. For example, let us take three events; the creation of the Interfaculty (event I), me writing this essay (event E), and the climate disaster leading to a rise in sea levels (event S). The first, called A-series, describes events as pertaining to positions in the past, present and future. I is in the past, E is in the present and S is in the future. On the other hand, the B-series is constructed on a series of mutual relationships between events. I is before E and S; E is after I and before S; S is after I and E. Both pertain to an ordered series, but where A-theory privileges the moment present and it is essential to time, in other words, there could not be an A-series in which the concept of time would not exist, the B-series does not depend on time (McTaggart 457–474). The latter does not essentially emphasize any moment, but quite the opposite. This has close connections with the theory of Eternalism, in which it is believed that all moments are equally important, treating events as if they are already there, part of block universes.

Within this context, the B-series of time and Eternalism are particularly relevant. Finally, if objects in this universe are treated as having temporal parts, that is, me having a beard simultaneously while writing this essay and me being hungry after writing this essay function as subregions of what wholly represent me, Luca. When an object is referred to, we only refer to its temporal part, not what the whole existence of the particular object is (Sider).

Just as Tralfamadorians, the extraterrestrial beings portrayed in Slaughterhouse-Five (Vonnegut), saw the universe in four dimensions, the experience of viewing the outputs from the Framulator is similar. Taking the premise that film is a time sculpture, that there is such a device that capture the particular events in this universe and stores time-frames as temporal slices in a universe-buffer, the simultaneous view of the bird in experiment#01, both flying, turning and resting at the sea represents the temporal whole of “bird”. Thus, the viewer gets closer to what I would understand as a posthuman experience of time, of four-dimensional beings. The whole chunk of time at that given universe-buffer blooms in a series of deterministic or stochastic decisions.

I would not undermine the power of this experience given the current situation we live in. Yes, the input videos are only experiments and do not portray any specific relevant issue in this temporal part of the Earth now. However, my motivation in building the Framulator is for further work, a tool that privileges the whole and subverts the normal understanding of the passage of time. What humans are experiencing amidst a pandemic and an absurd turn into fascist-like leaders, it is natural that a normal stream of events seems meaningless. Deconstructed time is born. A planned future based on past experiences together with present decision making is meaningless. When it comes to times like these, as Derrida claims, it is terrifying because it comes from the future, placing all of our motivations in a predictable future at risk (Wood 274–298). Past and future, synthesizing the present.

References

Xenakis, Iannis, and Sharon Kanach. *Formalized Music. Thought And Mathematics In Composition*. Pendragon Press, 1992, p. 43.

Roads, Curtis. *The Computer Music Tutorial*. 4th ed., The MIT Press, 1996, p. 169.

High, Kathy et al. "Analog Meets Digital In And Around The Experimental Television Center". *The Emergence Of Video Processing Tools: Television Becoming Unglued*, kathy High et al., 1st ed., Intellect, Chicago, 2014, pp. 531-549, Accessed 5 June 2020.

Bode, Peer. *Camel With Window Memory*. 1983, https://www.vdb.org/titles/camel-window-memory. Accessed 5 June 2020.

Langheinrich, Ulf, and Kurt Hentschlaeger. "POL Catalogue Ars Electronica". *Granularsynthesis.Info*, http://www.granularsynthesis.info/ns/?goto=pol. Accessed 5 June 2020.

Batty, Joshua et al. "Audiovisual Granular Synthesis - Micro Relationships Between Sound And Image". *Proceedings Of The 9Th Australasian Conference On Interactive Entertainment Matters Of Life And Death - IE '13*, 2013. *ACM Press*, doi:10.1145/2513002.2513568. Accessed 5 June 2020.

Forbes, Angus Graeme, and Javier Villegas. "Video Granular Synthesis". *Eurographics Digital Library*, 2015, http://dx.doi.org/10.2312/exp.20151192. Accessed 5 June 2020.

Noriega, Chon A. "Sacred Contingencies: The Digital Deconstructions Of Raphael Montanez Ortiz". *Art Journal*, vol 54, no. 4, 1995, pp. 36-40. *JSTOR*, doi:10.2307/777692. Accessed 5 June 2020.

Ortiz, Raphael M. *The Kiss*. 1985, https://www.youtube.com/watch?v=_RP__fcstT4. Accessed 5 June 2020.

Scheer, Edward. "Instance: Granular Synthesis, Modell 5 (2001)." *Mapping Intermediality in Performance*, edited by Sarah Bay-Cheng et al., Amsterdam University Press, Amsterdam, 2010, pp. 115–122. *JSTOR*, www.jstor.org/stable/j.ctt46mwjd.21. Accessed 5 June 2020.

J. Ellis McTaggart. "The Unreality of Time." *Mind*, vol. 17, no. 68, 1908, pp. 457–474. *JSTOR*, www.jstor.org/stable/2248314. Accessed 5 June 2020.

Sider, Theodore. "Four-Dimensionalism." *The Philosophical Review*, vol. 106, no. 2, 1997, pp. 197–231. *JSTOR*, www.jstor.org/stable/2998357. Accessed 5 June 2020.

WOOD, DAVID. "ON BEING HAUNTED BY THE FUTURE." Research in Phenomenology, vol. 36, 2006, pp. 274–298. JSTOR, www.jstor.org/stable/24660642. Accessed 5 June 2020.