Pandemics, Delays, and Pure Data: on 'afterlives' (2020), for Flute and Live Electronics and Visuals

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Abstract: The essay addresses creative and technical aspects of the piece 'afterlives' (2020), for flute and live electronics and visuals. Composed and premiered in the context of the COVID-19 pandemic, the composition employs audiovisual processes based on different audiovisual techniques: phase-vocoders, buffer-based granulations, *Ambisonics* spatialization, and variable delay of video streams. The resulting sounds and images allude to typical situations of social interaction via video conferencing applications. 'Afterlives' relies on an interplay between current, almost-current, and past moments of the audiovisual streams, which dephase the performer's images and sounds. I have avoided, in text, delving deeper into the Pure Data abstractions and or into the musical analysis of my composition. The main purpose of the text is rather to present compositional/technical elements of 'afterlives' and discuss how they enable new experiences of time.

Keywords: Pure Data, time warping, phase vocoder, live electronics, multimedia composition.

In this essay, I present creative, technological, and conceptual aspects of my piece *afterlives* – for flute and live electronics/visuals, made with *Pure Data* and *GEM*. The piece was written in 2020, in the context of the COVID-19 pandemics, and premiered in the same year during MUSITEC2: an innovative online event on music, new technologies, and creative practices held by professors/researchers of 10 different Brazilian public universities. *Afterlives* was premiered online by Gabriel Rimoldi, to whom the piece is dedicated, at the closing concert of MUSITEC2, on December 4th, 2020[1].

Despite its starting point – the idiosyncratic description of a subjective creative experience –, the text highlights the interweaving of poetical, technological, and social issues that constitute the piece. While presenting the general mechanisms of real-time audiovisual processes extensively explored in the composition, the discourse centers into the piece conception in the context of the technological mediations of social and audiovisual interactions during the COVID-19 pandemics. Thus, I have chosen to address the piece and the live electronic processes it relies, in dialogue with some of my conceptual and theoretical research topics on music and technology, avoiding a mechanistic explanation of the technical processes involved. My objective is to present compositional and technical elements of the piece while discussing how the electronics, algorithms, and technical mechanisms consist of poetic constructions that enable me to build new experiences of time. These elements are related to a social, political, and existential dimension globally marked by the COVID-19 pandemics.

1. Technological and cultural artifacts of the 2020's

Since the advent of music notation, new technological resources and media have opened new ways of experimenting and speculating about time. According to François Delalande (2001), music notation was not only an innovative technology for subsequent transformations in compositional explorations, allowing for new formal and textural elaborations by composers such as Guillaume de Machaut. It may also be considered as the pivot of a *technological revolution* with regard to music

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[1] More information about MUSITEC2 and about the MUSITEC research network can be found at <https://sites.google.com/view/redemusitec/>. Accessed on: 15 nov. 2021.

creative practices. While notation was, initially, a resource used to transcribe pre-existing music, since the 14th century, composers like Machaut explored it to create procedures like retrogradations and other compositional operations. In this process, notation passed from a mere resource of "conservation and transmission (…) to a tool of assistance to [artistic] creation" (DELALANDE, 2001, p. 32–33). Delalande sees in the electroacoustic tools a similar process. Media and technical resources originally conceived to record, transmit, and preserve sounds/music became, gradually, to be explored in creative practices. "Just like notation was the instrument of the polyphonic invention, the different electroacoustic techniques are the tools of an elaboration of 'sound'" (DELALANDE, 2001, p. 41)

Delalande's concept of *technological paradigm* defines, despite the risk of positivist interpretations, the relationship between the features of these different technical contexts and the artistic possibilities brought by them[2]. This relationship is linked to a much broader aspect, which is quite explicit in the work of archaeologists, like André Leroi-Gourhan, and technology theorists, like Gilbert Simondon. Namely, the fact that technological tools and objects are not only cultural artifacts, intrinsically tied to the human reality and to a people's way of life (SIMONDON, 1989, p. 9). They are, especially for very ancient human groups, the most reliable traces to any attempt of understanding habits, values, rituals, and collective fate (LEROI-GOURHAN, 1984, p. 11). From their study, paleoanthropologists are able, even after millennia, to deduce some characteristics that concern the mediation between time, technology, and the human activities related to them: the time, for instance, needed to prepare and mold clay in pottery works or to extract the fibers of a plant and, from it, enable processes of spinning, sewing, and weaving[3].

If this relationship between technology and culture serves us to think about the past, it is also convenient to reflect on the present. As in a fictional exercise, let us imagine a far future in which, as in Bradbury's *Fahrenheit 451*, little of our written culture would have remained. However, the techniques, machines, software, and digital devices would somehow have succeeded to be conserved, just as the ceramic vases, spearheads, and burial urns used by humans from millennia ago. Paleoanthropologists of this future era would rummage our archaeological site. They would find

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[2] For a broader discussion on the concepts of *technological paradigm* and *scientific paradigm*, see KUHN, 1996 and DOSI, 1982.

[3] Cf. LEROI-GOURHAN, 1984, p. 154–171; 179–199, for a good example of these investigations.

plastic bottles, smartphones, electronic thrashes, and all imaginable consumer gadgets and wastes of our late-capitalism societies. Somehow, these researchers would also be able to "excavate" all the digital tools we use today: text editors, messaging applications, internet browsers, programming languages (e.g., Fortran, Common Lisp, C, Python), computer music tools (e.g., music V, Csound, Max, Pure Data), and all the variants of video conferencing software (e.g., Zoom, Meets, Skype, Teams, Jitsi).

What would they say, based on these techniques, about our technology-mediated relationship with time? Thinking particularly about the period of the pandemics that took the world since 2020, what inferences could be drawn about how we socially and subjectively relate to time in processes that vary between synchronous and asynchronous – such as the algorithms of video conferencing applications stretch and compress video and audio streams to compensate lags and connection issues?

After hours and hours of remote classes and meetings, of many sessions of *lives* with concerts, roundtables, and talks, watching colleagues and students in matrices of video tiles in my monitor (many of them only displaying names and muted mic symbols), I had the insight to compose a piece based on this topic. From these ideas and a paronomasia that led me to the title of the piece ("Will there be life, after these 'lives'?"), I started to work on my project.

2. Audiovisual patches and processes explored in *afterlives*

The piece's main idea is straightforward, involving a creative interplay between the performer's live sounds/images and immediate past events. The first live-electronics compositions – not to mention all polyphonic genres based on imitations and canons, such as pieces by Ockeghem and Machaut, for instance – have explored extensively similar processes of time manipulation. While these first experiences of employing live electronics as a means to manipulate time relationships rely mostly on tape delays, I have decided to work with phase-vocoders, granular processes, and video delays. The visuals of the piece, made in GEM, clearly allude to the graphic interface of video-conference applications: with the particular feature that the 5x5 tile matrix only exhibits images captured by the camera in front of the performer. From the beginning of the piece, the image frames of the camera are stored in a circular video buffer. Similarly, a circular audio buffer records the flutist sounds,

allowing DSP processes to access past moments for granular and phase vocoding processes that embed *Ambisonics*[4] encoding for enabling the further flexible spatialization of computer-processed sounds.

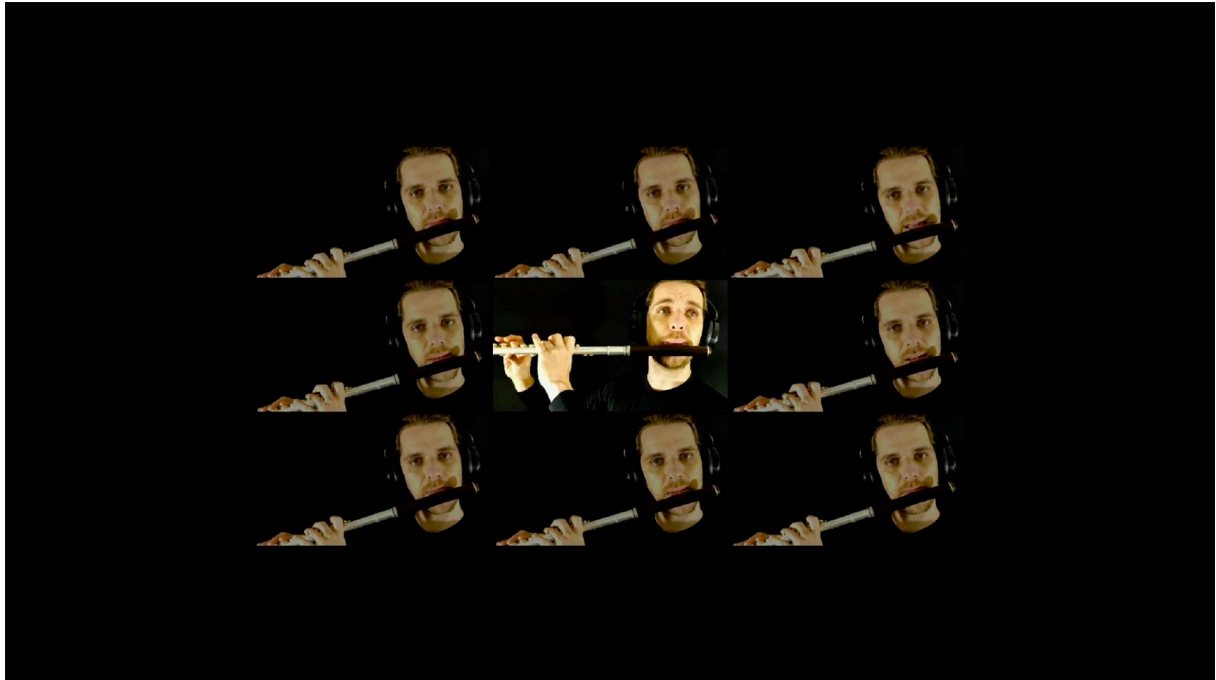FIGURE 1 – Pure Data audio/control patch of *afterlives* (2020)
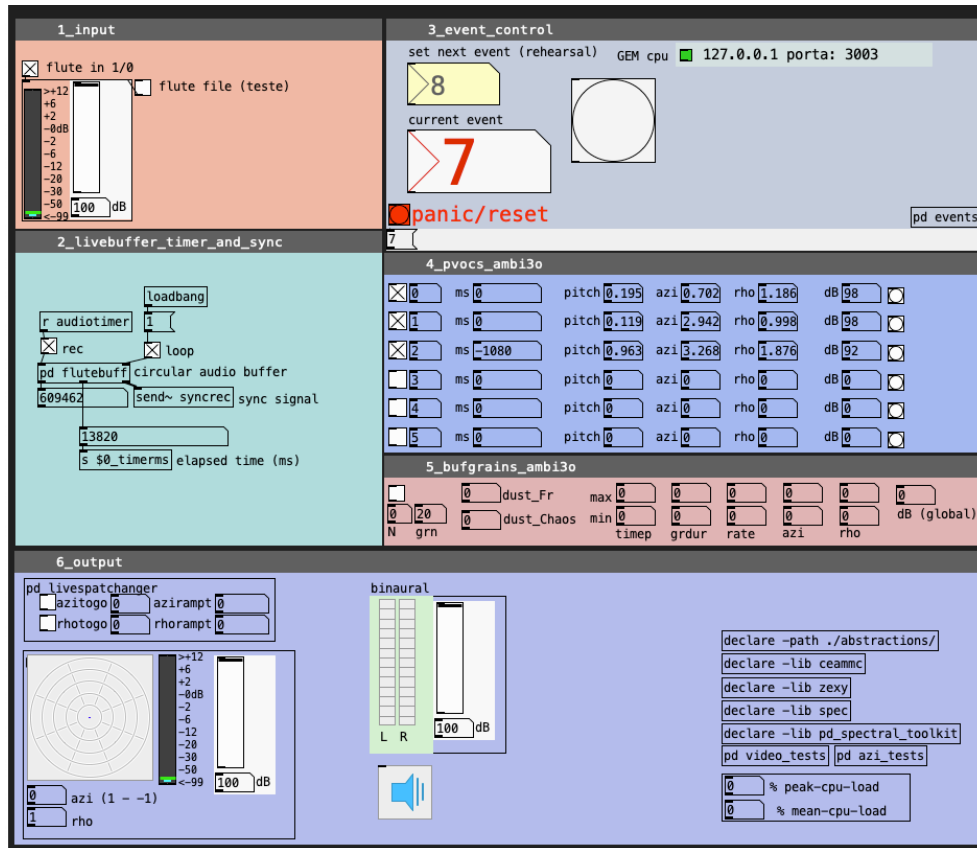
Source: the author

The audio processing patch consists of six main parts, shown in Figure 1. In `[1_input]`, it is possible to control and monitor the input level of the flute. Audio is internally routed to a 3rd order *Ambisonics* encoder, allowing for flute spatialization without further processing. This allows placing the sonic image of the acoustic instrument in the final audio projection space. This module also sends the input audio stream to an array, in module 2, that records the flute since the beginning of the performance. The second module `[2_livebuffer_timer_and_sync]` stores and records the input and sends a sync signal `[send~ syncrec]` that registers the current sample of the array in which the flute sound is being recorded and the current time, in ms, elapsed since the beginning of the recording

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[4] For papers and tools using *Ambisonics* processes in Pure Data, see: SÈDES; GUILLOT; PARIS, 2014; MUSIL; NOISTERNIG; HÖLDRICH, 2005.

process. This sync signal is used throughout the piece both by the six instances of phase vocoders –
[4_pvocs_ambi3o] module – and by the buffer granulator – [5_bufgrains_ambi3o] – to,
respectively, perform independent time/pitch time-warping processes (phase-aligned phase vocoders)
and buffer-based granulations that have variable control parameters of timepoint, grain size, playing
rate, azimuth, and rho control.

In the [3_event_control] module, the event-based logic that controls the patch is
programmed. This includes an event counter and a mechanism that stores the moment (in ms) in
which each event occurred. This module also contains [qlist] based abstractions where different
events and commands are prescribed. They include all the audiovisual parameter changes, automated
routines, and other processes that are expected to happen in each event of the piece. This also includes
OSC messages that are to be sent to the video patch and parameters changings that switch or control
processes performed by all audiovisual processing modules.

The [6_output] module allows monitoring and control output level and also to check the
flute spatialization. In the current version of the piece, structured for performance via the web, all
sound processes, previously encoded in 3rd-order *Ambisonics*, are decoded for binaural projection.

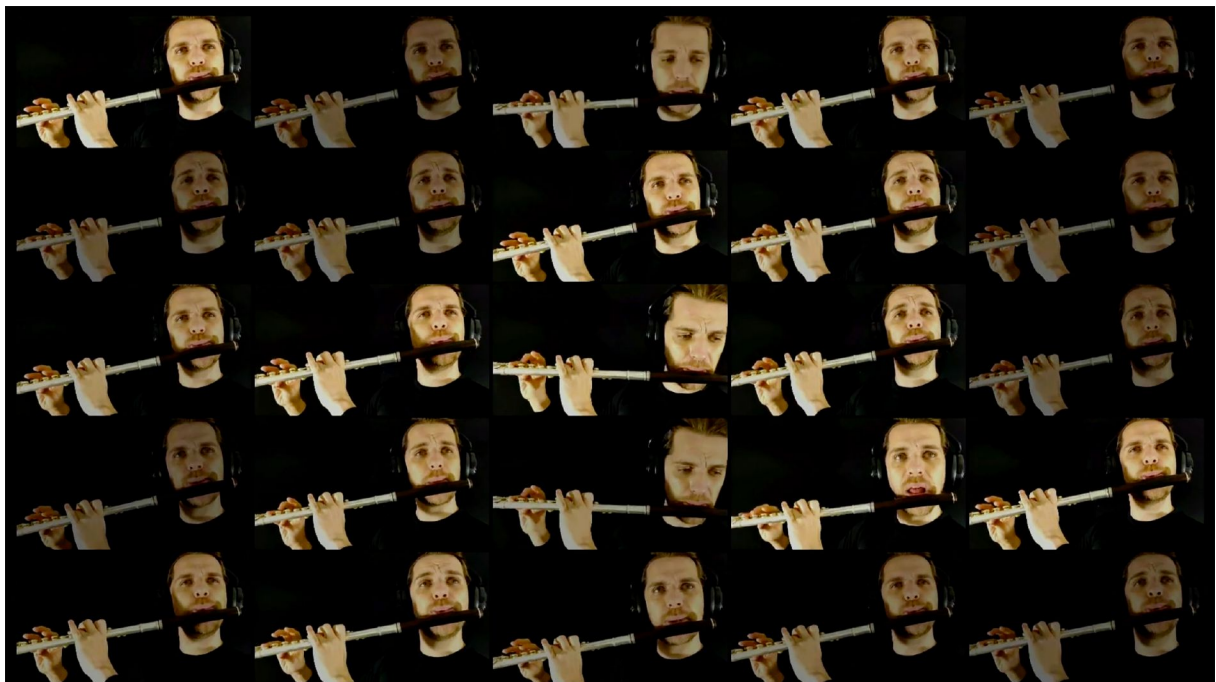FIGURE 2 – Video Pure Data patch of *afterlives* (2020)

Source: the author

FIGURE 3 – Video frame of the first section of *afterlives* (2020)

Source: the author

FIGURE 4 – Tile delays and alpha manipulations in *Afterlives* (2020)

Source: the author

The patch that performs the visuals works as a server (Figure 2). It receives commands as OSC messages from the main audio patch and, according to these instructions, performs visual processes using the GEM external objects. Internally, the patch implements an OSC message manager: similarly to what happens in software aimed at VJing, it is possible to control remotely parameters related to the video size and the alpha channel of each of the 25 tiles used for the piece. It is also possible to delay each of the video tiles: after starting the camera using the object `[pix_video]`, the video stream is recorded in a buffer using GEM objects `[pix_buffer]` and `[pix_buffer_write]`.

The algorithm's logic is similar to the audio abstraction mechanics previously described and relies on video buffering. The process enables accessing previous frames captured by the camera and creating visual time-warp processes analogous to those explored, for the audio, with the phase-vocoders. The abstractions use ramps – created with `[line]` objects – to control the sonic and visual processes. The ramps allow specifying the timepoint, relatively to the present moment, the audiovisual process will move to, as well as how long it will take to reach these past moments. For the phase vocoder, this allows creating both subtle delays, in which one of the phase vocoder instances becomes slowly out of phase with the live flute, as well as more fast or abrupt time jumps. In these cases, going fast from the current time point to one more far away, in the past, will result in reversing the sound. Otherwise, going from the past to the present gradually will invariably result in an acceleration in relation to the original tempo of the recorded audio.

The frame delay and the alpha channel of the video tiles are manipulated according to values set for each event – just like happens with the audio processes. This is explored creatively to generate sensations of synchronicity and asynchronicity. In the very beginning, for instance, the alpha channel is brighter for the tile that is not delayed, while the surrounding 8 tiles are a bit darker and the other 16 are completely dark (Figure 3). Later, when all tiles have already appeared, the alpha channel manipulations do not follow this same logic. This makes it more confusing to realize which video tile has no delay (Figure 4).

3. Experience and perception of time in *afterlives*

Poetically, the audiovisual time manipulations explored in *afterlives* are not so much intended at inculcating the question "*which video tile or sound layer is the 'live' one?*". In fact, although it may arise, this question would reduce to a foolish test an aspect that interests me much more to work on: to build an audiovisual/temporal texture that is not only marked by the multiplicity of images and sounds but also by a multiplexed experience of time in which emerges polyphony of current, almost-current, and past moments. The very dephasing of reality, of what we call "now", and what we call "then". This elastic notion of time is, for me, a way to think about my own perception and memory, and is related to what Henri Bergson once conceptualized, in *Matiére et Memoire*, as the "thickness of duration".

> In fact, following to the end the principle that we have laid down, and according to which the subjectivity of our perception would consist above all in the contribution of our memory, we will say that the sensitive qualities of matter themselves would be known *in themselves* from within and no longer from without, if we could free them from this particular rhythm of duration which characterizes our consciousness. Our pure perception, in fact, so rapid that we suppose it, occupies a certain thickness of duration, so that in the successive perceptions are never real moments of things, as we have assumed up to now, but of moments of our consciousness[5]. (BERGSON, 1985, p. 72).

The flute, the flutist image, the score, the sounds, the Pure Data processes are, here, gears of an imaginary time-machine, a techno-cultural artifact that makes me possible to wander around my own time perception, to walk between what we would call "instants", to build my own time. It is a time-machine, but not in the sense of enabling me to travel to the past or to the future (as my phase vocoder and my video delays may deceive me to be able), but in the sense of creating new time experiences. A "device" whose purpose, after all, is not so different of the ones used by Machaut and Ockeghem (notation) or explored by Kagel and Stockhausen (tape-based delays): to build something like what Silvio Ferraz calls *transversal-time*.

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[5] In the original: "Suivant en effet jusqu'au bout le principe que nous avons posé, et d'après lequel la subjectivité de notre perception consisterait surtout dans l'apport de notre mémoire, nous dirons que les qualités sensibles de la matière elles-mêmes seraient connues en soi, du dedans et non plus du dehors, si nous pouvions les dégager de ce rythme particulier de durée qui caractérise notre conscience. Notre perception pure, en effet, si rapide qu'on la suppose, occupe une certaine épaisseur de durée, de sorte que nos perceptions successives ne sont jamais des moments réels des choses, comme nous l'avons supposé jusqu'ici, mais des moments de notre conscience."

> Transversal-time is a privileged field for experimentation in musical listening and composition, and even in practices of instrumental music. Focusing on what happens between images, I do not talk about sound objects, musical gestures or formed musical figures, but about the subtle operations that take place in the interstices or intervals of the musical mechanism, and which refer to what I understand as constituting the machinism internal to music. Music in this sense is a machine that gives body to a very specific time: a time-music. This is a different time from the one grounding our everyday, which refers to time measured by seasons, ages, and so on. I think of this other time, time-music, the time of the music-machine, as being transversal, a time born from the vertiginous linking of micropoints, where opposed or continuous forces are articulated. This time unfolds infinitely in a profusion of local images that, even if local, insist on a pure memory unaffected by action: the abyss, distances, the proprioceptive and exteroceptive relations that trigger the tactility of texture, the visibility of figures, the kinetics of gestures when listening to sounds. (FERRAZ, 2021, p. 79–80).

4. *Liveness*, *live*, and *afterlives*

With the escalation of electroacoustic technologies, loudspeakers, and earphones became practical tools to listen to non-electroacoustic music. This privative and digitally mediated relationship to music is, along with the individualistic aspects of modern life, a striking feature of contemporary music listening and consumption processes. Today, it is seemingly that only some professional instrumentalists listen more to non-electronically mediated music than to digital recordings using electroacoustic transducers.

With the 2020's pandemic, something analogous happened to our social life. Speaking for myself, in the last 16 months, I have met more people via video conferencing applications than in my "real" temporal and spatial environment. If in my daily life I meet my family (my wife and my couple of children and not more than 10 people, counting relatives that we meet occasionally), every week I meet dozens of students, colleagues, and friends remotely, talking to my microphone, gazing at the screen of my monitor, hearing their voices in my earphones, being watched through a webcam. Our "live" interactions simulate, with little video tiles and stereo systems, the real-life interactions we had to suspend.

In *Living Electronic Music* (2007), Simon Emmerson develops some concepts to think about creative practices related to *live electronic music*. Working with dualities like *body/environment*, *local/field*, and *real/surmised* causality, Emerson managed to build a consistent theoretical enterprise on this topic, managing to contextualize historical, aesthetical, and technological aspects of live

electronic music, taking into account other practices, ranging from acousmatic music and mixed music to live-coding.

His elaboration on this topic starts from the difficulty, admitted by him, of defining what 'live' is, in this context.

> The idea of any 'live' music is increasingly difficult to define, but there stubbornly remains much music which demands human presence and spontaneous creativity (physical and mental) in its production. (...)
> 'Live' will here mean:
> • The presence of a human performer: who takes decisions and/or makes actions during a performance which change the real sounding nature of the music;
> • this embraces the historically accepted view of the 'live' as involving a human: who produces sound mechanically; or who produces sounds on electronic substitutes for mechanical instruments using similar physical gestural input;
> • but it also includes one: who does not mechanically cause the sound, yet who may cause, form or influence it through electronically mediated interfaces under their immediate control. (EMMERSON, 2007, p. 89–90)

Is *afterlives* (2020) really a 'live electronics' composition? All its construction, performance, and recording mechanisms depend on the *human presence* of the flutist. Indeed, as the piece would be premiered by Gabriel Rimoldi, not only an extremely skilled flutist but also an excellent performer of interactive audiovisual compositions, the very conception of the interactive visuals, even if conceived in this version to be displayed in monitors (the same *locus* where we experience video conferencing applications), counts on his live expressive gestural interpretation. His present and past *presence* in the 25 tiles, with different delays and brightness levels, create a kind of visual dance that, together with the spatialized layers of sounds, makes it possible to potentiate the dualities of synchronicity/asynchronicity explored in the piece.

On the other hand, just like any live electronic piece, I have designed the visuals and sonic processes to dispense the edition of audio and video files – except for displaying credits at the beginning of the video. However, the video and audio needed to be synchronized to generate the final file streamed in the "live" premiere concert on YouTube. Well, the irony: a *live electronics* piece that explores the actual presence of the immediate past images and sounds and depended, for its inaugural concert, on a fixed media (streamed as a "live" concert).

5. Conclusion

I have intentionally avoided, in this short essay, going into greater detail about phase-vocoding processes, buffer-based granulation, *Ambisonics* spatialization, etc. The eventual description of these specific technical strategies will have space in other texts, articles, and didactic activities/materials.

Similarly, I have avoided falling into the ouroboros analyzing in details my own piece. First, because I don't believe much in these self-analytical rituals. Second, because I consider that the poetic aspects addressed throughout the text, in dialogue with technical strategies employed in the piece and social context that surrounded its composition, can better inform an eventual approach that goes back in more detail into other relevant compositional elements: timbre, harmonic design, texture, exploration of the particularities of the flute form, "comprovisation", and even discussions focused on categories and topics such as scenic music, and media theory, for instance. It is noteworthy to mention, for that matter, that the patches, score, and video recording of the piece are publicly available, allowing for the eventual analysis of such details. The video recording of *afterlives*, with binaural audio, is available at *YouTube* and *Archive.org*[6]. The score and the Pure Data patches are available at *GitHub*[7].

It is relevant to say that the patches and the score are being constantly revised so as to correct minor bugs and to improve the notation of the score and the performance of the audiovisual processes. For instance, I plan to implement the visual processes of *afterlives* in *openFrameworks* or *ofelia*[8] and further explore *GLSL* processes, what could probably enhance the visual processes explored in the piece.

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[6] <https://www.youtube.com/watch?v=8wJMP_BDsFo> and <https://archive.org/details/afterlives-2020>, [Accessed on: 20 nov. 2021].

[7] <https://github.com/zepadovani/afterlives_2020>, [Accessed on: 20 nov. 2021].

[8] <https://openframeworks.cc/>; <https://github.com/cuinjune/Ofelia> [Accessed on: 20 nov. 2021]

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