Live 4 Life: A dream for a free and open spatial performance tool towards symbiosis or death?

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Abstract

This paper presents the motivations, evolution, and directions behind the spatial sound performance tool named *Live 4 Life*. It aims to simplify the creation and control in real time of masses of spatialised sound objects on various kinds of loudspeaker configurations (stereo and particularly quadriphonic or octophonic setups, as well as domes of 16, 24 or 32 loudspeakers). This spatial research, which questions ways of associating rhythmic and spatial parameters, is based on the concept of free and open works, both from the point of view of form (improvisation) and in the diffusion of the code. The tool, which was initiated in 2011 and distributed in open source in 2022, has been conceived as a long-term dream against capitalism and loneliness. Several scenarios between (technical, social) death or symbiosis of this tool (with other programs, people, works and the visual representation field) are presented.

Keywords

Sound performance; spatial improvisation; computer-music; SuperCollider; open source; custom tools; ephemeral; GUI; patterns; algorithms; controllers; interdisciplinary research-creation; graphical representation, audiovisual.

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Introduction

In a context of increasing demand for and supply of sound spatialisation systems and tools[1, 2] it remains however particularly difficult to dynamically and simultaneously control multiple sounds in real time in the concert hall space, due in part to the stratification of the composition process in several software programs and the complexity of individually spatialising a multitude of sound events. To meet this need, the tool *Live 4 Life* (1), mixing rhythm and space, offers a spatialisation control structure, including a library of predefined spatial trajectories and rendering algorithms, mixing both channel-and object-based paradigms and abstract and concrete spatial techniques.[3] Following philosophical reflexions and the presentation of the underlying principles of the tool, we speculate on two future scenarios for the tool, either death or symbiosis. In this paper, we will see how an artistic intention along with a desire for a singular and custom spatial composition paradigm led to the development of an open-source tool, namely *Live 4 Life*.

A dream for Free and Open living Art

Like the composer Francis Dhomont,[4] as a composer and performer my main concerns in music, art and life do not concern those of "pure music," referring only to itself, but touch on extra-musical themes (capitalism, free parties, loneliness). I (Christophe Lengelé) could qualify my sound improvisations in the same way as Francis Dhomont does for his piece *Phœnix XXI*: "a music that is abstract in its realisation, but figurative in its intentionality."[5] My improvisations thus question, via the tool and the way of creating, the most important themes in my life and offer my interpretation of society, as expressed by Luigi Nono, which is quoted by Joshua D. Parmenter (a long-time developer of SuperCollider) in every email on the SuperCollider mailing list:

Every composer—at all times and in all cases—gives his own interpretation of how modern society is structured: whether actively or passively, consciously or unconsciously, he makes choices in this regard. He may be conservative or he may subject himself to continual renewal; or he may strive for a revolutionary, historical or social palingenesis.

The project *Live 4 Life*, which is a form of resistance to this imposed world, was born from the desire to reconnect with life. It was created in response to the world and the environment (societal, family and personal) in which I lived. I thus reflect in my improvisations this individualistic world and my disillusioned way of facing it, by trying to use free code as much as possible, so as not to reproduce and encourage this commercial world. Without my personal experiences or traumas in my family or in the professional world, having worked in multinational companies in the fields of banking, industry and communication, my intention of wanting to create this project in open source might never have seen the light of day.

Not wishing to adapt my ideas to a commercial product, I chose in 2011 to develop my own spatialised sound performance tool on the open-source SuperCollider platform,[6] with the ultimate goal of going beyond the simple sharing of listening or looking. Indeed, the ultimate objective was to tend towards a liberalisation of modes of creations, focusing more on doing it together outside the market and the sharing of creative practices open to all, by giving all the code developed over the years, like many artists who distribute their codes in open source, such as Fredrik Olofsson (2) or CHDH with *egregore* (3) or *vivarium* (4) projects.

The series of performances on capitalism *Free parties will survive*, addresses the relationship to money, property and this desire to always want more. It represents my hatred for this inhuman system for me, by using and opposing it with hardcore sounds from the free parties of the 2000s, just as harsh, symbolising a certain desire for revolt, freedom, anarchy. In my opinion, the capitalist system exacerbates and uses the failings of man such as selfishness. Unlike Adam Smith, who relies in particular on this character trait to lay down the main principles of economic liberalism, I can only believe in a system that promotes and encourages the values of equity and sharing. In the same way as the composer Raphaël Cendo, I try to resist this capitalist system (5) by taking little interest in the production of a (musical) object for an object or in the transmission of perception, but to the concrete way of realising a sharable object or transmitting an experience. However, I consider that the discourse has little scope without a voluntary act accompanying the thought. That is why my only way to deal with capitalism, was to offer improvisations from free and open source creation and production tools.

I also have my contradictions and my development limits, in the sense that I also use commercial products, especially with controllers or the Mac computer. However, I try to tend towards free, at least in terms of software. Currently, I do not use Linux, because a lot of

spatialisation systems I used were connected in ethernet with Dante, which does offer drivers only for Mac and Windows. The use of Linux would then have required the purchase of an expensive and bulky sound card. And, if I chose to use cheap and professional commercial physical controllers, it is so that anyone can make the tool their own, without having to build their own interfaces.

According to Jacques T. Godbout, "the work of art is a gift because the gift, [...] is what confirms to one another that we are not things."[7] How then to express this gift in music, electronic performance or digital art? Is showing or hearing an experience or a composition a sufficient form of expression and sharing? How to transmit more and create stronger links with others, by making the barrier that separates the researcher artist from the public fade and that the latter exchange their roles? Similar to Ursula M. Franklin, who distinguishes prescriptive technology from holistic technology,[8] my tool and technology practice aims to focus not just on what is created and entertainment, but on the how and how the work is done though code sharing and future training workshops or participative performance installations.

On the grave of Karl Marx, there is the following epitaph: "The philosophers have only interpreted the world in various ways. The point however is to change it." Although we cannot radically change the world, I also expect from an artist a real desire for concrete action for a fairer world. The development, promotion and almost exclusive use of open source software represented my utopian way of changing my world, however small, like a little dust to stop the capitalist machine. However, by persevering in this radical position, I have also excluded myself from the "world", because I no longer consider the profusion of electronic productions made with commercial software, even if I may like them, because they do not intrinsically transmit the idea of sharing and are not intended to put into questions dominant positions in society.

Besides free and open source objectives, putting bites of his/others lifes in art is also essential for me. What Alice Neel said to painting is applicable to every form of art:

"One of the reasons I painted was to catch life as it goes by, right hot off the griddle. Because besides painting specific people, I'm painting all the happenings [...] and I've tried to capture the zeitgeist. When painting or writing are good, it's taken right out of life itself, to my mind, and put into the work. Now, that doesn't mean that the work has to tell about real life. I mean, it can be abstract or anything. But the vitality is taken out of real living and put into the creative project, whatever it is."

The characteristics of the performance tool

Live 4 Life is not only a spatialisation tool, but a whole sound creation system to play with sequences of parameters (rhythm, spectrum, space and effects), integrating spatialisation at different levels, both at the heart of each sound synthesis and each loudspeaker. It is first thought for spatial performance with several global, high-level (indirect) control strategies, e.g., by swinging among scenes of spatialised events or by changing masses of parameters, particularly playback speeds with different mappings according to each controller [9] (see figures 1, 2 and 3).

Dynamic, finite event-based spatialisation

Here, we propose a distinction between continuous input-based spatialiation vs finite event-based spatialisation. By continuous input-based spatialisation, we mean that the user selects the position or trajectory of each continuous input (like in most spatialisation plugins such as Ircam Spat). By finite event-based spatialisation, we mean that the user selects (among a pre-defined library) the position and trajectory for several layers of events with different times of beginning and durations (like in some creation systems allowing to control both time and space of events, such as *Live 4 Life* or Sound Particles). With the tool we focus on event-based spatialisation since it allows to control the temporality (rhythm, density, duration and amplitude) of spatialised sound events, as shown in figure 4. According to the author's experience in creation, continuous input-based spatialisation tends to create more simple and clear spatialisation, while event-based spatialisation tends to create more complex and confusing spatialisation.

A library of trajectories and algorithms mixing abstract and concrete spatialisation techniques

It integrates a pre-defined library of multiple spatialisation models[10] (see 5/ and 6/ of figure 5): point granulation,[11] temporal micro-decorrelation,[12] trajectories drawn, generated algorithmically or according to the spectral analysis of the sound signal [13], rendered according to several spatialisation algorithms (equal-power panning, delay-based panning, Vector-Base Amplitude Panning [14]).

Figure 1: The performance tool with all its controllers in 2021: in the center, the computer GUI with the performance view and keyboard shortcuts, one Akai APC Mini at the top left, two iPads with Lemur Application on both sides of the computer, two Midi Fighter Twisters and one Sensel Morph at the right).

Figure 2: Picture of the performance tool in concert during JIM (Journées d'Informatique Musicale) in 2019. The whole performance, which was spatialised with a ring of 8 speakers and recorded in binaural, is available at https: //youtu.be/NfWXF6copEs.

Figure 3: Picture of the performance tool in concert during Akousma Festival in 2021. The whole performance, which was spatialised with 3 rings of 8 speakers and recorded in stereo, is available at https://player.vimeo.com/ video/747391295 at 1h20'40". ©Akousma / La Conserve Media.

We categorise two main kinds of spatialisation from the point of view of the composer.[3] Abstract spatialisation, which refers to a specific spatial trajectory or precise position applied to a sound, is present in almost all spatialisation tools, possibly since it is direct and the most controllable and the easiest way to abstractly conceive a position in space. Concrete spatialisation takes more into account the internal characteristics or parameters of the sound, either with correlation by linking a spectral parameter or intensity of the sound to a spatial dimension, or with micro/macro decorrelation—for example, on time, playback speeds, transposition or distortion—which tends to create a diffuse/contrasted space. It is very difficult to predict the spatial effects or diffuse perception of some concrete spatialisation techniques like micro-delays or transpositions, where location is no longer the focus, rather than width and depth, as it indirectly acts on space through parameters of the same sound different in some or all the channels of the loudspeakers.

Algorithmic patterns of parameters mixing rhythm and space of sound events

Sequences of parameters allow to create sequences of spatialised sound events or choruses (copies or echoes of the same event with micro-delays or spectral/spatial variations) that can meet a multichannel effect system with different effect parameters on each loudspeaker.

Figure 5 shows the Sequence View to compose patterns or algorithms for all parameters (rhythm, density, sound synthesis, space and send to effects). Time control is not represented with x-time axis, but with multisliders, where you can draw a list of onset values or durations (see modules 1 and 3 of figure 5). Besides euclidean algorithms controlling rhythm, a topographic drum sequencer from the Eurorack module Grids has also been integrated into the tool thanks to the port in code to SuperCollider [(6)].

Figure 4 shows two views of a graphical representation with x-time axis of a sequence of events with different parameters. The difference between the top/bottom representations is the density parameter (see module 2 of figure 5), where all events are generated at the bottom and only some of them at the top. It can be obtained by changing a slider, at the right of each parameter module, which multiplies the values of the multislider. The sound events generated can then be each spatialised and routed to specific effects particularly thanks to modules 5, 6 and 7 of figure 5.

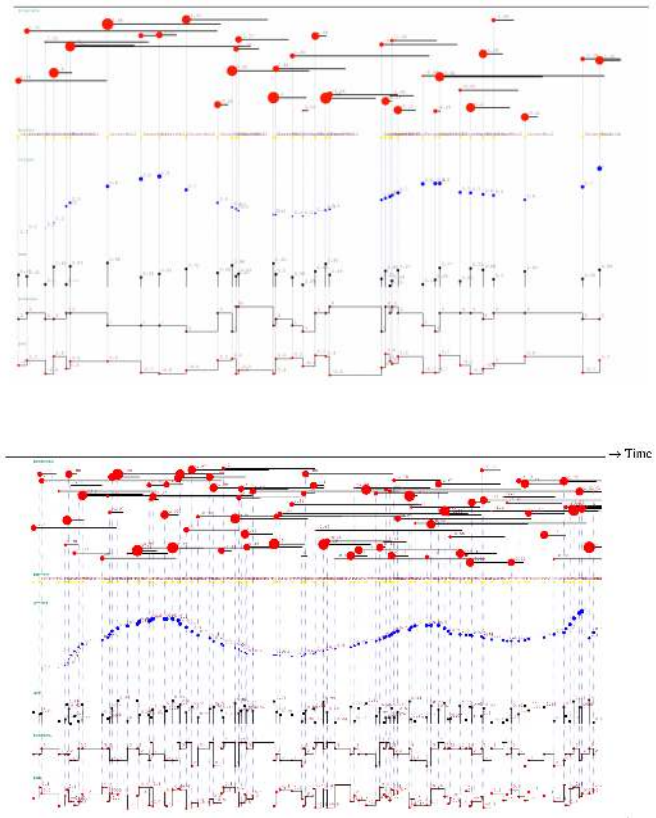

Figure 4: Two different views with (low/dense) densities of a graphical representation with x-axis time of the same sequence of sound events with different parameters on y-axis. At the top of each view, red circles (bigger or less depending on amplitude) mark the beginning and the black line is the duration of sound events. The y-axis of red circles represent playback values of sound files, which can be negative depending on the value of the blue line representing the position in the sound file, which in this case is the same with the points in yellow. At the bottom, three parameters are shown: amplitude, spatialisation type and pan levels. Both representations of patterns of parameters were realised thanks to the SuperCollider extension *PatternPlotter* from Jonatan Liljedahl: https://github.com/lijon/AlgoScore2.

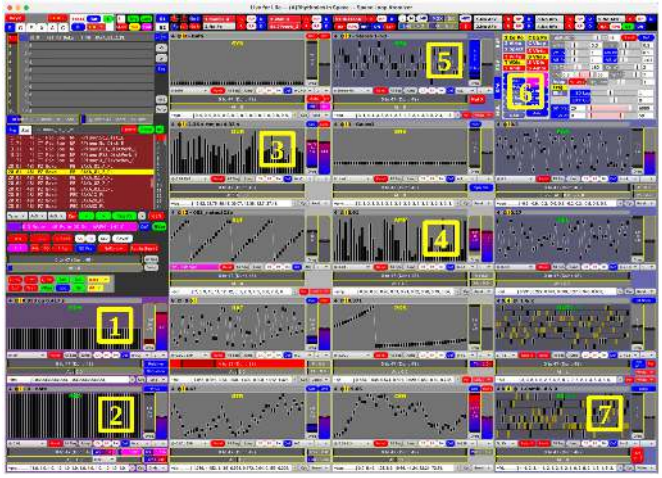

Figure 5: The Sequence View to compose fixed or algorithmic patterns for all parameters of the sequence of 48 sound events in this case: with e.g., at the bottom left, 1 rhythm and 2 density modules; in the center the spectrum of the sounds with 3 duration and 4 amplitude; at the top right 5 spatial trajectories and 6 algorithms and at the bottom right 7 the send to a selection of multichannel effects.

Mixing object-based and channel-based paradigms

An object-based paradigm (sound sent to a virtual 3D position) involves that spatialisation can be easily reproduced to other different spatial configurations, whereas a channel-based paradigm (sound or effect sent to a physical loudspeaker position) involves that spatialisation cannot be reproduced in the exact same way on different loudspeaker configurations.

According to the author's experience, the simple treatment of channel-based paradigm of sending directly a sound to a loudspeaker channel tends to reinforce the presence of loudspeakers and have a low CPU usage, which has the effect of increasing the maximum number of spatialised events in real time, while object-based paradigms tends to make forgive the presence of loudspeakers and be more CPU demanding, which has the effect of lowering the maximum number of spatialised events in real time.

Despite the tendency towards object-based paradigm for reasons of standardisation and reproduction in every space regardless of speaker setup, mixing channel-and object-based paradigms to be used on every sound event allows to take advantage of the strengths of channel approach. Sending a sound directly to a specific loudspeaker can have much more impact (and at least a different effect) than sending it at the exact same coordinates of the loudspeaker through e.g., VBAP algorithm. However, it has also the effect that sequences integrating channel-based or a multichannel effect system are different according to the number of loudspeakers available and cannot be reproduced in the same way on different loudspeaker configurations and have to changed with other spatial trajectories or algorithms. Depending on the spatial configuration, different spatial algorithms are available. For example, in stereo, trajectory types are only limited to three (static panning between links and right, one way or round-trip between links and right), as well as the panning algorithms (equal power, delay-based and spectral).

The possible roads towards death

The tool *Live 4 Life* faces two main reasons that might cause its future end.

Technical death

As most Digital Musical Instruments, this tool is ephemeral due to technological obsolescence. Maintaining the code with recent updates of MacOS or SuperCollider platforms and solving bugs is a considerable burden. Some controllers have disappeared such as the Sensel Morph [(7)], the MIDI Touchbar [(8)] on older Macs, where I could get sliders integrated with the keyboard. Other Applications like Lemur [(9)] on iPad, which took me months of work to integrate within my tool, have temporarily stopped their development, and the use of this application with next iOS updates is currently not guaranteed.

Social death

At its creation, the two motives behind the development of this tool were the realisation of spatial improvisations in concert and a means to connect with others. The tool until now has lived because I had the chance to perform in concerts. The pandemic has not helped, but the current difficulty to find residencies or perform spatial improvisations in concert halls or festivals in good conditions may cause future death of this tool: without an appropriate allowance and a minimum time of a few days to prepare and adapt the spatialisation of works to the space and spatial setup of concert halls. Since concert halls with spatial setups are in great demand, time for creation and repetition is often limited. Without a space with several loudspeakers and a user to perform or the help from other developers/collaborators/users, this tool will die.

The possible roads towards symbiosis

Knowing the aforementioned risks, we now turn toward preventive solution avenues that will lead to a shared tool. The spatial sound performance has many links with symbiotic individuations both between machines, programs, works from other human beings (notably electroacoustic composers), the audiovisual domain and other communities.

Symbiosis between Code and GUI and Controllers

To extend the possibilities of algorithmic patterns, I first thought to integrate besides SuperCollider the use of other live coding languages, such as TidalCycles,[15] by controlling pre-programmed code in real time via DJ interfaces. This was realised thanks to a developer who implemented my request [(10)] of being able to trigger via MIDI or OSC any parts of code in a text editor through the encoder of a controller. However, first tests showed CPU and synchronisation issues when using both text editors for SuperCollider with my tool and Atom for TidalCycles.

Symbiosis with other programs

As it is possible to see on the installation section of webpage of this tool, it is a patchwork of multiple codes from various sources. To extend the possibilities of digital signal processing, integration of open source or relatively free VST plugins is currently investigated, with plugins such as Surge XT [(11)], Vital [(12)] or modular systems like VCV Rack [(13)]. More precise spatial algorithms with Higher Order Ambisonics will also be implemented in the tool via Sparta[(14)] or IEM plugins [(15)].

Symbiosis mixing electroacoustic works

I initiated just before the pandemic a new cycle of improvisations dealing with living alone and the feeling of loneliness, with the absence of symbiosis, whose Greek root means "living together." My way to deal with the hell of loneliness has been to symbolically ally myself and associate closely with other electroacoustic composers (Bernard Parmegiani, Francis Dhomont and Robert Normandeau until now), reusing and recycling their own sound materials and compositions. The willingness of this performance is to dissolve myself in the creation of someone else, in the same way as I dissolve the composer in my tool, in order to destroy the ego and go towards symbiosis. I, therefore, included in the spatial performance *Parmegiani meets SuperCollider* [(16)] three major works from the electroacoustic composer Bernard Parmegiani, which are rearranged, processed and triturated by the machine algorithms and my gestures.

The primary sonic source consists of 2-hour records from the electroacoustic composer Bernard Parmegiani, i.e. *De Natura Sonorum*, *Rêveries* and Hell from Dante's *The Divine Comedy*, which have been cut in more than 1.700 sound samples and classified in dozens of folders.

These sound files have been cut so as to obtain and mix a wide variety of sounds of different durations, both isolated elements and repeated a few times to have a brief musical phrase. The sound database has been grouped into fifty folders differentiating between the original tracks and my own sound categories (short/long durations, soft/violent elements, resembling instruments / natural elements or voice). Similarly to the cut-up technique, which was popularized by writer William S. Burroughs, these sound files are then rearranged and spatialised in enveloping vortexes around the audience. Their tempo and playback speeds are frenetically modified, thus accelerating or slowing down the lives of large amounts of sound objects.

Audiovisual symbiosis

Audiovisual perception Although, by definition, acousmatic music allows us to focus on a single sensory modality in order to better perceive sound information and free our imagination, multi-sensory integration helps and has a strong impact not only on object discrimination and reaction time to events, but also on emotional response, particularly in the peripersonal space.[16] Perceptual and cognitive mechanisms are made to process signals that are of multiple sensory nature. Given that an individual can no longer integrate two sensory information and identify the source of the event when the spatial or temporal delay is too great,[16] it would be possible to play on joint or disjoint audiovisual spatialisations. In the same way that certain studies, exploring the associations between sound and visual dimensions, suggest that a sound parameter can correspond effectively to several visual parameters[17] and especially that the choice and sense of the scale correspondences would have more importance than the correspondence itself,[18] the same relationships and associations could be made between the sound, the visual and its space, where multiple relations can coexist.

Audiovisual creations To meet the needs for audiovisual and more immersive works for the eyes, an audiovisual object could be composed by transmitting via the OSC protocol the synthesis parameters of each audio event from the Super-Collider language to audiovisual programming environments, such as Processing or Open Frameworks, in order to represent each sound object with a virtual graphic object, a symbol, a video or an image, whose position, playback speed, offset, transparency, movement or other video effects will be controlled by the sound synthesis parameters. Sound images could be able to rotate like on record players depending on their playback speeds. Audiovisual composition can also be used to generate symbolic scores, so that this representation sheds light on the process of composition and improvisation.

First experiments with Processing are shown in figure 6. Simple shapes are triggered with OSC from sound event data, distinguishing percussive sounds with cubes from others with spheres, accumulating by transparency. Forms disappear by transparency and distance following the duration of sound events. Playback speed was mapped to the vertical position, panning to horizontal position, intensity to the vertical size and transparency, the duration to the horizontal size and transparency and the buffer folder to color. Streaks deforming forms can be seen when triggering some shortcuts changing playback speeds of sound events. A similar patch has also been developed in Touch Designer and will soon be available on Github.

Audiovisual collaborations Audiovisual collaborations are looked for both with video developers to create the visual from the sound data generated, and with dancers to finally assess the impact between the gesture of the performer, the dancing bodies and the video environment. Technically, the audiovisual object mapping could be developed through open source tools, such as Processing, Open Frameworks, Hydra, or even through commercial tools like Touch Designer and Resolume, as long as the creation process and the code are published on Github and open to everyone.

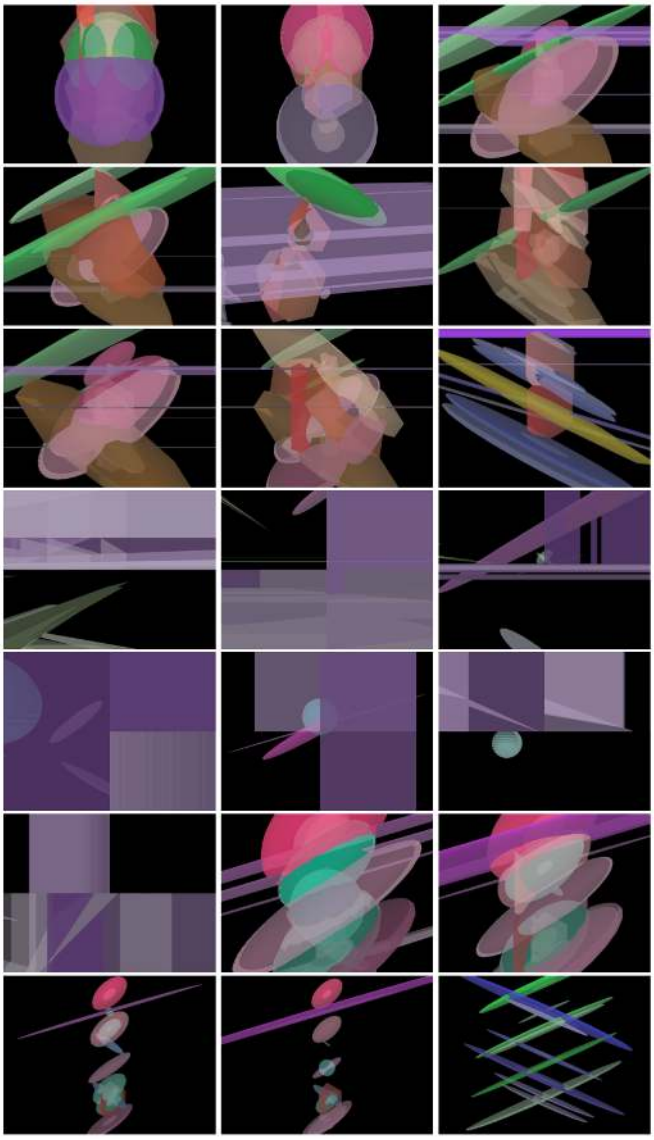

Figure 6: 21 screenshots of realtime representations of playing sound events with different parameters sent by OSC to an experimental patch in Processing generating different forms based on circles and squares accumulating by transparency.

Conclusion and future work

In this paper, we explained the free and open source motivations of the tool and its main characteristics of event-based spatialisation. It will live until there is sufficient funding, a user/developer team, an appropriate environment with spatial setups in concert halls and enough time to adapt pieces to concert space. Otherwise, without collaborators and users, it will soon die. This current research-creation project in spatial improvisation (sound and multi-sensory) has three axes:

• Thecreationofperformativeandparticipativeinstallations, where the public will be able to experience in real time the control of the parameters of multiple sound objects in space via several interfaces. The sound performance tool will thus be evaluated by the public, both from a perceptual point of view and in terms of control and ergonomics.

• The establishment of training workshops to use and experiment free tools to create and improvise with space,

• The creation of spatial improvisations in a multi-sensory context, combining and alternating music, video / light and dance.

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Authors Biographies

Christophe Lengelé is a spatial sound designer and performer for electronic and experimental music. After a Doctorate in music (composition and sound design) at Université de Montréal in 2022, he is currently doing a postdoctoral research/creation in spatial improvisation at UQAM (Canada). He seeks to bring together the spheres of composition and improvisation and focus on performing variable spatio-temporal pieces with a global custom live tool, he has been regularly developing since 2011, in order to play the place and the music at the same time. His works have been presented and performed internationally, particularly at the International Computer Music Conference (2018, 2021), during the Journées d'Informatique Musicale in France (2017, 2019), as well as at Akousma Festival 2021 (Canada) and more recently at Cube Fest 2022 (USA).

Philippe-Aubert Gauthier received a B.Ing. degree in 2000 and a M.Sc. degree in active control of vibration in 2003 (Université Laval, Canada). From 2003, Mr. Gauthier was enrolled at Université de Sherbrooke (Canada) from which he received a Ph.D. degree in 2007, dedicated to adaptive wave field synthesis. He is interested in spatial sound, multichannel sound reproduction, audio signal processing, room acoustics, loudspeaker and microphone arrays, spatial hearing and psychoacoustics. He was adjoint professor at the Mechanical Engineering Department from 2017 to 2019. He then took up a professorship at the École des arts visuels et médiatiques at UQAM (Canada) in 2019. He is a professional sound artist, an electronic musician, working at the intersection of arts, sciences and technologies. He is currently the associate director of artistic research at CIRMMT (Centre for Interdisciplinary Research in Music, Media, and Technology).