Orbital Eccentricity. Sound performance, using commercial and military satellites with real time tracking data

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ABSTRACT

This music performance starts with an inquiring about the possibility to generate sound and music elements using commercial and military satellites, established in a process of acquirement and conversion of satellite movement data *sonified* in real time, merged to midi-data language. Used to control hardware and software musical instruments. It's importance, reflects on the autonomy of the satellites as objectual performers, actants that generate sonic content in an ecology of casual movements and programmed computational music rules. The routes and trajectories are mediated elements to think about composition in a performative dynamic environmental system, manipulated in real time by the performer in direct dialog with the external technological body. The satellite as an actant suspended in the edge of the human perceptive border that articulate a direct relation with the planet Earth as a place with external telematic objects. It represents the human activity in the boundaries of the universe limits. This performance starts with the production of hardware and software that captures the movement of public and military satellites. In technical collaboration and partnership with Christopher Zlaket (1992) from the Arizona State University who specializes in interface design and David Stingley (1993) of MIT who specializes in computer science. The sonic qualities are dependent of improvisational approaches developed in real time, pointing to aesthetic elements about dynamics, granulation, noise, and drone. Pointing to post-digital and micro sound aesthetics traditions and proposing ruptures.

CCS CONCEPTS

• **Applied computing** → Arts and humanities; Media arts.

KEYWORDS

Sound art, Sonification, Micro Sound, Performance

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1 SATELLITE, PERCEPTIONAL EXPANSE AND MEANING

Art deals with representation and the expansion of perception. Then we can mention that satellites underpinned this transformation. The satellite launch Sputnik 1 on October 4, 1957, from the former Soviet Union contributed to the beginning of the space race and thus to a decentralization of representations in art and society. It changed the perceptual field of a generation for the space-universe which, in turn, generated a new set of decentralized images and possibilities in art and technology that I conceptualize as "the noise of satellites" [3]. Art explorations beyond the horizon, the marker of the traditional distance in visual representation. The satellite brings the fading of the horizon in a spectral light, opening a new time of the darkness space expansion. This expansion of representational space, and place impose questions about the humancentric positioning and dilate the imaginary understanding of the possible limit, which is important to represent something that is distant for the bio-mechanic eye and ear. From this moment on, the reality and the virtual are in symbiosis. This transformation exposed by science and technology, not only influence science fiction, but multiple art forms, and the social fabric. Generating new discourses on technologies, connectivity, place and representation beyond the eye and the ear. The set of this concepts elaborate in music and sound repercussions, mainly because music and sound deal with primitive perceptions, emotions and feelings projected beyond the materiality aspects of object reality. If we approach sound as an event that emerge between contacts of objects but is not in the object itself. It is an immanence projected in the space, like the light of a dead star at millions of light years. Sound is an event in a state of emerging and decay, in the atmosphere that is received by the ear, accessed by remembering the event. Understanded by memory as a ghost, or something that is beyond the materiality and the substances of the system world. We can say, the ear is a primitive organ, it never closes like the eye that we project in the cosmos

today with sophisticated telescopes. The lessening processes propose a continuum of multilevel conscience operations articulated by memory. Sound like light are events that expose conscience to the virtuality of absence, achieved by imposing objectual bases in a conceptual frame that connects the specter to the object throw language and meaning.

Based in this consideration: How can we work with sound and understand the absence of the universe and the technological bodies "satellites" that we suspend in a distant place, part of the idea of sonic and visual landscape?

Can we use this technological bodies as systems to generate composition and performative collaborations exploring telematic considerations of locality?

How can the obscure and danger universe serve as imaginary to engage creativity in art?

What strategies can we use in art to problematize this idea with the actual technology?

What are the implications of composing and performing in collaboration with a technological artefact like the satellite?

These are some questions that are fundamental to stablish representation ideas in sound and musical methodologies that we use, interlinked with concepts like absence, orbits, radiation, telematic mediation and technologic and natural universe electromagnetic noise. Maybe all the inquiring serves the motivation to achieve future conclusions. But, for now, it is interesting to understand and mention that Sputnik 1 was the first human object in space to emit sound to Earth and to the universe at the frequency of 20 and 40 MHz, which caused long-distance communication and the appearance of a new element, sound device, extraterrestrial that connected directly with our planet by sound interaction. Today we can count on many operational satellites that, in a way, generate an extraterrestrial symphony, that manifest our presence in the universe.

1.1 Satellites, implementation and collaborations

On September 3, 2016 one of Hugo Paquete's spatialized sound composition for 24 audio channels titled Unevenness from 2015 was sent into space in a chip integrated in Nasa's OSIRIS-Rex, mission towards the asteroid 101955 Bennu. The probe landed in August 2018 on the asteroid that describes an orbital period of 1.20 year (436.65d) at a speed of 28,000 meters per second.

> "Hi Hugo, we wanted to let you know that we received your composition for the #WeTheExplorers campaign, and it will be included. Thanks for participating. Social Media Lead Office or the Principal Investigator OSIRIS-REx Asteroid Sample Return Mission". [4]

Hugo Paquete's composition as an artefact it's in a distant, "orbital body" and extraterrestrial position, as an element of human culture that is deployed in the conquest of new frontiers. The spaces of intervention of culture artefacts, human presence in cosmos, as well as the expansion of the field of visual representation and sound reproduction. The distant territory of 101955 Bennu is the field of new stationary, silent and representational possibilities accessed by human imagination and high-tech evolution. Transforming the Unevenness composition into a silent cultural artefact of intergalactic connection, only achieved by specialized technical means that can transpose the light distance. Between 2019-2020 Hugo developed the work Dromology of Orbital Bodies (2019-2020) and the composition Apoapsis (2020) and Periapsis (2020), this last created with the hardware constructed to tracking satellites in real time.

This current research and project have been developed with the support of the following partners, presented in no particular order: European i-Portunus Project, Emerge: Contemporary Art Agency of Portugal, FCT: Foundation for Science and Technology and, finally, the ZKM/HERTZ-Laboratory for musical research in the ZKM/ Center for Art and Media in Karlsruhe, Germany, during the time Hugo Paquete worked in project and composition as resident artist (1).

2 RESEARCH OBJECTIVES

This project developed a way to hacking the satellite system in a "techno-urban-guerrilla" attitude [6]. The objective is receiving the real-time information of the satellite trajectories and movement, and to rethink possibilities of using this information to produce sound, and an autonomous performative entity in the context of music performance. The solution was to find an IP with the information from all the commercial and military satellites with real-time updates. This issue was fundamental to the project because the composition had to be generated in real time. Therefore, access to "information streams by the satellites" was critical, for the "cultural sonification" processes involved, where are designed the aesthetic flows, of data conversion and the compositional rules. This situation was solved with the development of software and hardware developed with Arduino-uno in partnership with my collaborators Christopher Zlaket and David Stingley. This research uses hacking techniques to enable the collection of information from commercial and military satellites to think sound production, composition and performance strategies of "sonification in sound arts" [5].

2.1 Hardware technical objectives

Here are listed the technical objectives of this work:

- Develop a hardware system capable of tracking satellites in real time based on their Norad Id. North American Aerospace Defense catalog. Number, Norad Id, Nasa catalog number, USSPACECOM.
- Build a software to establish the connection with the data collected from the satellites in real time.
- Establish a relationship between hardware and software to convert the received data to MIDI protocol.
- Fabricate the necessary conditions and system so that the sonification of the information received from the satellites can control software and hardware.
- Implement sound organization models and treatment of the data received from the satellites converted to MIDI to be able to control virtual and analogue instruments.
- Elaborate recordings in real time of the sound generated by the built system.
- Organize the collected sound material and build virtual instruments and sound libraries to use in future musical works.
- Establish means for the system to be used to explore ideas of music composition, sound design and spatialization, based on its contact with satellite orbits.

Figure 1: Hugo Paquete working in the Dromology of Orbital Bodies at the ZKM/HERTZ-Laboratory for musical research in the ZKM/ Center for Art and Media in Karlsruhe, Germany, 2019.

- Explore the implementation of this technology and the achieved methods and results in performative context.

2.2 Software technical objectives

The software was programed to convert the satellite data in this order. Connecting the orbital movement and the object satellite state based in longitude, latitude, and azimuth. Data position in relation to earth.

- Midi channel 01: longitude. Just one Note connected with the satellite movement.
- Midi Channel 02: Latitude. Just one Note connected with the satellite movement.
- Midi Channel 03: Azimuth. Just one Note connected with the satellite movement.
- Midi Channel 04: The combination of all Notes cascading from the Channels 01, 02, 03.
- Midi Channel: 05: longitude. Just CC values: CC 3, CC 9, CC 14 to15. CC random number connected with the satellite movement.
- Midi Channel: 06: Latitude: Just CC values: CC 20 to 31, CC 85 to 90. CC random number connected with the satellite movement.
- Midi Channel: 07: Azimuth: Just CC values: CC 102 to 119. CC random number connected with the satellite movement.
- Midi channel 08: CC Values: CC 1, CC 2, CC 10, CC 11, CC 12, CC 13. Selection of random number CC values connected with the global channels Note and CC.
- Midi Channel from 14 to 31, CC Values CC 71, CC 72, CC 74, CC 77 to 79, CC 85 to 87, CC 89 to 90, CC 91, CC 92, CC 94, CC 102 – 119. Selection of random numbers of CC values connected with the global channels Note and CC.

The set of these values gives us the change to filtrate the movement and Midi information to generate signal and data processing with other hardware and software tools. Manipulating the data based in this sonification methodology produces the aesthetic qualities and impermissibility necessary for the implementation of this compositional and performative ideas.

3 RESULTS: COMPOSITION APOAPSIS AND PERIAPSIS

The composition Apoapsis explores the idea of distance between oblique orbital points and paths, tensions, and attractions between sound bodies of different granular scales that are shaped by impulses and percussive impacts. A wrapped universe of constant interactions where musical forms, sound masses and noises develop various attractions and repulsions in constant micro rhythmic and harmonic turbulences.

The Apoapsis concept comes from the term “apsis” which is the farthest point from the center of attraction: the high point in an orbit. This concept is fundamental to understand the work, considering that its production involved real-time “data” from satellites converted into musical models and expressive sound forms. The sound produced in the composition are self-referential to the satellite movement. The composition Periapsis is a composition that refers Apoapsis and works together with it, when presented as an installation, or in performance situations. There is also the combination of the elements generated in real time by the satellite tracking system. The concept of Periapsis refers to the point of closest approach between an object moving in an elliptical orbit over another celestial body. The presented concept of elliptical trajectories in the two pieces, was used to develop an oblique distribution of sound throw a multichannel audio system. It is used a circular looping strategy to structure the musical piece and progression inspired in the satellite orbits, and there is a direct relationship with the pitch variations with the satellite movement, that influences the chord progression and timbrical elements.

The two compositions explore a dramatic aesthetic, with dynamic temporal formulas generated with material collected in real time, spatial variations, timbre variations and collisions between rhythms approaching a “negative beauty” [1] (p. 102) with the objective of “pushing of physical, physiological, and psychological limits, these works use consonance and tonality, foundations of the language of Western art music” [3] (p.103). In this composition we explore a harmonic expansion centered in noise, that resemble the technological and natural electromagnetic sound, this generate a granular turbulence in space.

The masses of sound generate a granulation effect through which impulses cross the conceptual space, freezes, and are transformed into residual elements of fragmentation in the threshold of sonic perception. It is explored a formal aesthetic micro sound direction of fast attacks that applied stylistic transitions that are eccentric, crossed by a shower of white, pink and brown noise like meteorites or sand. Joana Demers says that, in these practices, noise is a means of “trigger auditory hallucinations” [1] (p.105). In our opinion, it is still representative of a sublime experience of transcendence through technology, capable of generating abstractions. Therefore, technology in these practices is always a means of meaning production and the bearer of an aesthetic of its own that lies beyond its functional meaning. We can thus say that electronic music artists live a state of ambivalence between the fascination of technological transcendence and its critical approach, as in the concepts of post-digital. The granular sound and noise effects generate micro rhythmic changings in time. Establishing relationships of actions

and reactions on a micro and macro sonic level that are in my argumentation the central aesthetic base for the post-digital music practices.

> "These sounds of failure are evocative because they allow musicians and listeners to demystify technology, which otherwise threatens to become ubiquitous and therefore unquestionable. Glitch noises, in other words, force listeners to reassess the definitions of admissible and inadmissible sound in the musical work." [3] (p.73)

In this works, we put into practice some concepts that Hugo Paquete is dealing and exploring in his music and composition methodologies related to an aesthetics where rhythm and noise are articulated, building micro-temporal, dynamic and detailed sound events that deal with residual sound events and ideas of micro-rhythmic collisions, orbits, obliquity and unpredictability of the constructed systems and their autonomy.

It is a symbiosis between control, chance, selection and performative interpretative gesture, response, and real time improvisatory approach to music composition in direct connection with the satellite and its autonomy. Turning to a sound that seeks an extreme in its granular, micro sonic and impermissible representations, bringing the opposites of the scales from the macro to the micro sound, "microsound: its use of what practitioners and listeners consider to be nonreferential, precultural sounds" [1] (p.76).

4 ORBITAL ECCENTRICITY

The music performance and improvisation Orbital Eccentricity is developed with material form the Apoapsis and Periapsis compositions. It proposes an improvisation in real time with a satellite that will be chosen to develop the performance in a direct connection. The generated sonic material will be processed in real time and mixed with other recorded material from past experiments generating a Drone: "excels in creating and maintaining tension. It aestheticizes the doom, opening a door onto once and future catastrophes" [2] (p.7). In this articulation of sound events, taken from the *sonified* data are a torrent of non-musical "raw materials" [1] (p.137) elements that generate turbulence and sound "maximal objects" [1] (p.102). Unpredictable elements are assumed and integrated into the production processes in a constant performative relationship with the "satellites noise" [3].

Despite we are dealing here with an open composition, we stablished 20 minutes as its desirable duration.

Concerning about the technical implementation the work requires internet connection, specific hardware and software constructed to the project. Moreover, we need to dispose of two Zoom Arq 48 and two Zoom Arq 96, sound mixer, sound card, notebook and other software and hardware.

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In these experiments, linked to micro-sound and noise, what we can hear is noise as meaning and presence, something dissonant and drone generated by machines and human data organization and anesthetization. Which explore the production of sound linked to the absence of signal generated by the data that is a non-sound, as a organizational act, and which seeks knowledge through the erratic and experimentation, with a view to a state of transcendence in which the body and technology merge and are conceptualized as vehicles of innovation wrapped in an aesthetic of contrariness and dissonance where the gross and the ugly are used as negative aesthetics. That said, there is a need to value the message rather than the channel, the signifying potential of the sound and music event alongside an interest in casual and unscripted events that are largely what build the methodologies of post-digital aesthetics. Experiment with art and technology in sonic performative context need to be an open process, in a constant negotiation.

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