Algorithmic systems and their processes for composition through the relation of medium-body-image
Case of study: Altamisa

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ABSTRACT

Algorithm composition, as a concept in musical composition, was first used during the 20th century to describe a mathematical set of instructions that results in sound composition. That does not mean this is a new practice or that it is something only for music and modern computers. Observing how Pythagoras created his 8-tone system of music, one can see evidence of an algorithmic system. In the field of visual arts, the same happens with the use of the Fibonacci series in visual compositions.

During the 20th century, the production of newer technologies and the modern computers allowed artists, musicians and other producers to quickly process complex mathematical lines of code and apply them in their fields. So the first questions that we have to ask ourselves are: What is algorithmic composition in the 21st century? What artistic production can we get from it? To answer this, we propose to use Hans Belting's system which connects three elements: Body, Image and Medium, by using an example to talk about this relationship through different space/time moments.

Author Keywords

algorithm systems, interactive, memory, space/time

1. INTRODUCTION

The link between art and technology is one of the most important factors that has characterised artistic production since the beginning of humankind. Musicians and visual artists (among other producers) have always explored the possibilities that technology offers to produce artistic pieces that can be heard, seen, studied and experienced. From this perspective, musicians and visual artists are constantly modifying their criteria to build and manipulate images though all kinds of technologies.

One of the elements that technology has brought to art is algorithms. Particularly in music, where they are used as a base for producing canons and rituals. Thus, conceptualised algorithms as mathematical rules have served to compose pieces, not only in music, but in many artistic expressions, that, in the last years, with the expansion of modern computers, have found their place in the world of contemporary art, in particular in the world of electronic, digital art and media art.

2. THE ALGORITHM AS A MEDIUM

When we talk about algorithms systems applied in arts and music, we may think that it is something new, that society started to use these processes in the last 50 or 60 years. With the internet and globalisation, these processes got bigger and more popular, creating links between disciplines that we relate and therefore call *transdisciplinary, interdisciplinary*, and *multidisciplinary*. But these processes are not new. For centuries, we have been learning through exchanging knowledge across disciplines as disparate as chemistry and literature, or others. This is reflected in the development of knowledge itself and its applications through human history.

The concept of technology is misused. Oftentimes, we use it only in the context of any production that came after the Industrial revolution. However, we can not forget that the word refers to any artifact or knowledge that allows us to solve a problem. The world "technology" in arts and music is linked to the medium. One appropriates tools and memories to represent the world. A paintbrush was the technology that allowed humans to produce refined textures on empty canvas. The same processes were made with the body as a technology when we represented the world in a crude way in caves. Likewise, the technological advances in acoustic instruments and other sound materials allow us to produce different ways of expressing music.

The application of algorithmic and mathematical systems in art and music is also a technology that has become a medium in which we transfer our memories through interactive experiences. The algorithm merged in these processes and allowed them to move into complex systems that construct a set of rules in the arts. One example is *Pythagoras' mathematical system* discovered around 500 BCE; This system set the rules for classic visual and sound arts.

Starting from this, it is important to contextualise the term inside a visual and sound image production in arts and music. The algorithm is a set of instructions that are formed by mathematical rules, providing a series of finite steps that have visual, sonic or conceptual outputs. The algorithm as a medium is understood as a mathematical system that sets the logic on which the image and sound objects will mix and behave. Such a medium gives the opportunity to the programmer, composer and artist to produce experiences where the outputs are translated into images and sounds that can be built by our bodies.

2.1. Algorithmic Notation

The term *notation* is usually used in music when we talk about an abstract sound language that communicates ideas to an interpreter/performer. Using Western classical notation, some producers have composed Classical music pieces. But during the 20th century, the

development of graphic scores represented an important path inside sound production. These were used in *music concrète, musike electroacustike*, and by composers such as John Cage, Iannis Xenakis, among others. Nowadays, both types of notation are used as a representation of sound in instrumental, electroacoustic and mixed music.

With the development of technology: modern computers, programming languages and other modern electronics, the use of notation has spread to other spheres of art. For instance, notation is now commonly used in interactive installations, fixed-media pieces and performances. Algorithms are also translated into programming languages to be used on computer software, presenting an open field that allows us to share more complex narratives.

Programs like Supercollider, Tidal, Fluxus and others, give producers the tools to share real-time pieces, where not only the sonic result is being shared, but the process itself is shown through a screen projection. The score is continuously being written and translated by the computer. Algorithmic notation is constructed by mathematical and musical/sound language; classical notation concepts can also be applied. Professor, musician and programmer Thor Magnusson has conducted a wide range of research projects that talk about interfaces which allow composition and notation with a real-time output.

In his paper "Code scores in live coding practice" (2015), Magnusson finds differences between notation that is to be read by an instrumentalist and that which will be read by a computer. In the first type of notation, he emphasises the human cognitive capacity for personal interpretation of a score. In the second type of notation, the computer does not function as an interpreter but as a direct input/ output reader. That is why the ambiguity and error in the score that is being read by the computer should not exist.

Even though Magnusson applied the concept of algorithmic notation in Live coding practices, these ideas can be also used in other musical contexts. Mexican composer Roberto Morales, in his piece *Un Presagio que se escapa de la mano* (2014), worked with percussionist Iván Manzanilla to produce a piece that used both classical and algorithmic notation in an interactive performance.

Roberto Morales programmed a series of automatons in Supercollider. Inside this piece, the automatons are part of the algorithmic score but they also function as interpreters and composers along with Morales and the percussionist. A series of musical notes, once performed, are translated in real-time though these automatons that project them into other sounds. Once this piece is presented again, the algorithmic notation and the classical notations are both important because they are used to produce the sound experience. This example shows how the concepts of classical, graphic and algorithmic notations can live together in the same space/ time to produce complex narratives that interact with each other.

Algorithmic notation can also be applied in visual arts. The code used in art projects can be seen as an algorithmic score. One example is reactive installations, where producers use software like Processing to set the lines of activities that a computer will run. Fluxus is a software where the projection of code produces a second visual output in real-time. Finally, it is important to notice that algorithmic notation requires not just mathematical knowledge, but also the understanding of sonic/visual elements and concepts like form, color, space, and pitch.

3.IMAGE CONSTRUCTION

If we consider an algorithmic system as a series of given steps leading to a positive or negative result, we are talking about a process. The construction of an image is a process resulting from an accident.

In this process, the steps are random because they recover the fundamental elements of organic mechanisms within the body: *recuerdo* [*Erinnerung*] and *memoria* [*Gedächtnis*]. Understanding

memoria as a body-archive of *recuerdos*, which are the individual images files that are produced after each experience. Hans Belting, in his text Image Anthropology (2007), recognises both mechanisms as anthropological elements in the production and consumption of images. The algorithm also has an anthropological character that produces and consumes images. Such processes do not simply result in something positive or negative (in mathematical terms), but as an uncertain, contradictory and random result in the human sense.

The phenomenon of mathematics is intertwined with the body which translates itself into data. This data is used in a series of actions that adapt the body to the everyday world, and the systems/machines it produces. The algorithms are systems that the body has constructed to understand the world.

The algorithmic construction is as organic as the body itself because the body is the place of the construction of images. From the point of view of Hans Belting (2007), the body is the place of images and the body lives through images. Such images can be recovered from individual or collective historical-*memoria*, or from immediate-*recuerdos*. These are part of a collection of archives and at the same time, they are the main elements for the construction of those images.

The body functions as a generator of individual images but at the same time as a generator of collective images. Images of the memory die when the body perishes and they respond to a space/time that belongs to it. Collective memories have their own mechanisms. They move in space/time as those living organisms that are constantly changing. Marcel Proust understood the mutant value of memory in his book "In Search of Lost Time: On the Road to Swann" (1913). In the book, Proust wrote about how a second before waking up, *recuerdos* of past rooms are pulled from the file of the *memoria*. All spaces/times exist together as one for only a second, and then they return the body's space/time upon awakening.

As we already mentioned: the body is perishable. It needs a medium to abstract the space/time of images, and then translate them into their own system of rules. The algorithm is used as a medium when we abstract our *memoria* to then organise them according to a set of mathematical rules. It recovers images that later on will be sent to the collective body by any means.

Even though medium-body-image are separate element, these three elements remain linked to each other and change roles constantly. Medium is understood as a rule system -in a technical and abstract way- that works as a bridge between body images that are invisible and images that are being produced and visualised through a set of tools and carrier objects. So the body works as an organic system that can produce and accept images. However, the body can be a medium itself in the way it produces and consumes alternative images. These three elements are important for the construction of sonic/visual experiences.

4.MEDIUM-BODY-IMAGE: ALTAMISA

Altamisa is an interactive system prototype currently in development. It has been used to exhibit a piece for cello and electroacoustic music. This piece has changed since its inception, and now involves not only an autonomous system that interacts with the instrumentalist, but also real-time sonic/visual processes.

The system/piece was built in its first phase as part of *Programa Prácticas de Vuelo* from the Mexican Center for Music and Sonic Arts, as a selected project from composer Emilio Ocelotl in collaboration with Brazilian/Mexican cellist Iracema de Andrade. During the last two months of the program, Emilio Ocelotl added a video part, developed by visual artist Jessica Rodríguez. The piece was performed several times between October and November of 2016. In every performance the piece plays with the same elements, but it is never performed in the exact same way because of its interactive processes. The project also involved the concept of space/

time and the different lines that run within the piece itself through a concrete performance space.

Image 1. Photo taken during a rehearsal at MUAC-UNAM
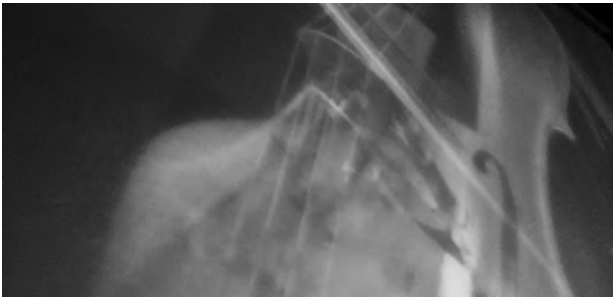
In the piece we have four main elements: composers -sound/visual-, interpreters, environment and the computers that are being used not just as tools but as carriers of a medium -system-. In order to explore this example, we have divided the analysis into three parts. The first part explores in a general way the technical components of the system: the set of rules and relations that the code/medium contains.

The second part is about the bodies: the artificial body -algorithmic system-, the physical body -instrumentalist- and their relation with different spaces that runs in several parallels space/time lines. Last, we will examine sounds and visual images that are constantly being constructed within the piece by using the body of the instrumentalist as medium, and its constant interaction with the algorithmic system: both from *recuerdo* and *memoria*.

4.1. The Algorithmic System as a Medium

Image 2. Photo taken during a performance at FAD-UNAM

Altamisa's system is programmed on Supercollider, and runs a fixed and dynamic electronic part. This system runs with a single block of code. At the same time at the beginning of the performance, this block runs from the beginning until the end of the piece and it is constantly receiving OSC messages that execute every routine. It has four important processes:

A. Sound recording and store machine. Using a recorder -*SynthDef*- that has a series of programmed synthesizers, the program records audio sections in real-time, generating .wav files. These files join with other sound samples previously recorded with the instrument to an archive that stores them for later use. All of this information is used indifferent triggered sections and as an impersonation of the piece itself.

B. Alteration of sound files from the sound archive. Using granular synthesizers, audio files are recorded, stored and called to be modified. This process happens with the previously recorded files and with the real-time recordings. This part of the code also adds

synthesizers, processing them with sound effects, and then it sends that information as audio output.

C. Audio output. The code has a series of programmed objects that sent local OSC messages that run specific events. These messages control the routines and also control at which moments the audio files are sent as outputs.

D_Routines. The code has 5 routines. These are in charge of determining the parameter of the granular synthesizers. They also run events which are the moments where the dynamic electronic is run, or when these buffers sound files come. The routines work with a timer -*Tdef*- that records the time from the beginning until the end of the piece, running each routine at specific moments.

Each routine has a direct relationship with its predecessor, specifically in the decisions regarding which sound files recorded in the last section will be used. This results in different paths for each route.

The instrumental part the piece has an open graphic music score that defines the series of routines and the transitions between them. The musician who plays the instrument has to interact with the fixed-electronic part and with its own recordings. You can see -on image 3- dotted lines that indicate possible paths between the beginning and the end in each routine. In the first movement of the piece you can find a fixed electronic state (this is where previously recorded sound files are run) and then, afterwards, the live-instrument comes to interact with the system. In the score, you can see that the x-states are marked (and hidden). These states are chosen by the transitions and represented the dynamic-electronic part.

Image 3. Altamisa's score
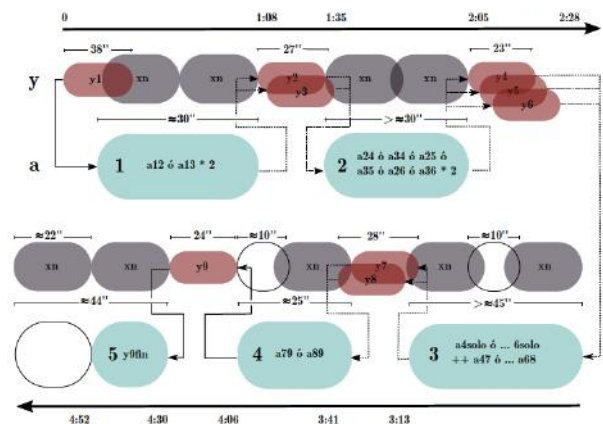
The performer has an important role in the piece. This one decides the future states of the performance. It is the performer's decision to follow similarity and dissimilarity criteria to engage with the fixed-electronic moments, and then to experiment in the dynamic-electronic part. It is when body recovers an important role, not just as an image producer but as a medium, or like a personal rule system that establishes the output reaction of each sonic and visual input. This rules system connects with the personal experience of the musician who plays the instrument, its experience in relation with the sound files previously recorded, and its understanding about the algorithmic system that has been used. At the same time, the instrumentalist uses her neuronal system of recuerdos and memoria that allows the instrumentalist to apply past experiences and academic background.

In the visual part, some similar processes from the audio part also take place. We cannot forget that this is a system that is under construction, so the first phase of the piece works with Resolume Arena to produce the visual composition. Even though this program

does not use lines of code, the interactive logic of the system remains. It runs not only previously recorded visual events, but also images that are being taking by a camera during the performance. Both layers of images are mixed in real-time while some parameters are being modified in relation with the sound output that becomes an input in Resolume Arena. Visual effects such as brightness, contrast, blur and frame-rate modify the visual composition.

4.2. Body Through Time

Image 4. Photo taken during a rehearsal at MUAC-UNAM

The body has a double function: as a medium and as a producer. The logic of the system takes the body to generate sound and visual images that are later modified, mixed and used in each performance. It is this moment when space/time occupies an important place in the construction of the piece. Two questions arise: What does space/time mean? and What is its relevance in connection with the elements that the piece has? Maybe the project does not provide a straight answer to the first question, since it is more connected with each members' personal *recuerdos* and their *memoria*. As for the second question, the body can not deny that it belongs to its space/time where it is settled.

Thus, the piece produces a general answer to the second question, since it has a past and future that are constantly being modified. Some of the sonic and visual elements that were recorded at the beginning of the project (in rehearsals and performances) are archives of *recuerdos*. These contain different space/time lines that had beginning and ending points that are mixed together in a memory: *La memoria de* Altamisa [Altamisa's memory]. There is also a real-time process that is presented through the sound and image live-recording (camera and microphone). This material is used during the performance but at the same time it is also recorded and stored to become a *recuerdo* of the piece.

The body of the cellist as a medium is one that uses its own *memoria* and *recuerdos*. Cellist Iracema de Andrade is influenced by a constant audiovisual input. This affects the way she responds to these impulses. It is also reflected in the sound/visual images that she continually generates. During the performance, all these space/time lines exist in one. All these *recuerdos* mix together, juxtapose themselves and interact with each other, living together in the same space/time and generating different experiences.

4.3. Continual Image Composition

While the code runs these fixed-electronic moments, it is the instrumentalist who runs the system. She is the one that takes the development and intensity of the piece, both sonically and visually. Every element is related and affects each other.

The piece has been presented four times, with each presentation performed in a different way. Even though we can note similar characteristics in each performance, the way the events were mixed and presented differed on each occasion. The first time, the piece was

presented in the *Festival Internacional Cervantino*, on October 12th 2016, in Guanajuato. Later, it was presented at the University Contemporary Art Museum MUAC-UNAM in Mexico city, on November 11th, and 12th, 2016. During these three performances, the piece was presented with its original set: video-electronics-cellist.

Image 5. Photo taken during a rehearsal at MUAC-UNAM

A remixed version of the performance was presented in *Sound Art and LiveCinema Sessions* at Design School FAD-UNAM on October 28th 2016; It was a Livecoding+Livevideo performance. In this case, both the visual and sound composer played and mixed with recorded images and their distortion. The interaction between sounds and visuals still happened (as in its original version), but in this performance the system also interacted with another body that manually ran lines of code by sending sound files and modifying parameters.

It is also important to mention that even if the system runs in an automatic way, the process of recording and previewing decisions are related to the composers. It is an anthropological research project, understanding the different members' backgrounds and exploring each one possibilities; it also explores the instrument in a sonic and visual way. Bodies are always present and have a direct influence on decision making. All of these are reflected in the algorithmic system and then on the images projected during performance.

So the system works as a series of rules, instructions and actions. These allow the composers to speculate, in a visual and sonic way, about the instrument and the results that these elements together could give.

4.4. A Project in Constant Mutation

Altamisa is not an infallible system. It is a system where one learns from mistakes made. It is a set of questions that are constantly generated: What would happen if the system does not have a visual and sonic input? How will the system react? What if other videos were involved in the visual construction? How could other visual bodies be merged with the cellist's body? How can one make the visual system run by itself? What would be the benefits of making the system completely autonomous? What would be the disadvantages of such autonomy?

All the questions that were generated when presenting the piece had to be resolved after. When performing the piece, there is no time to think about questions, but we can think about them afterwards. Any questions jump out of our minds when we review the presentation. That is how the project becomes a constant exploration, which is derived from the *recuerdos* and *memoria* of each of the people involved. This is also reflected in individual research projects.

The Altamisa system works as an application of Emilio Ocelotl's thesis research project, to exemplify how algorithmic

systems can be developed and work with basic programming concepts. Using the logic of programming languages from non-artistic applications, we can build environments and behaviours that runs through micro-controllers. At the same time, Iracema de Andrade takes the piece to exemplify the possible relations between interpreters and composers. The roles in these relations are blurred through interactive systems, which not only generate closed answers, but represent a challenge of constant composition for the player. Pieces with open scores not only allow improvisation within specific moments, but they also allow a constant dialogue. Finally the present research project explores the piece from a perspective of the relations between bodies, images and medium that are constantly changing roles.

It is then necessary, in the research stage of the project, to analyse how these three paths (with all of their particularities) have linking points. And how these linking points can be reflected in the practical part of the project, and consequently in the future performances of Altamisa.

Image 6. Video still for the performance at FAD/UNAM

5.CONCLUSIONS

The relationship between medium, body and image is an algorithm by itself. In this relationship we do not care anymore about the infinite conflict regarding what is first: the egg or the hen. Undoubtedly, the body is a tool that humans have to measure everything. The idea of someone will last longer that our physical bodies, what remains is what we have called *recuerdos* and *memoria*. *Memoria* and *recuerdos* can be individual or socially collective. With them we are able to build our society by keeping our past, making our present, and speculating about the future.

So, if we reduce an algorithm into a mathematical concept, we then lose the human potential it possesses. Processes are so important for us that we have discover that they are not as simple as we may have originally thought. Without them we would not have been able to discover our skills as composers, builders, and producers; We also would not have been able to discover how complex life is. If we are able to make a musical composition it is because we have, potentially, the facility to do so. If we are able to produce a visual image it is because we can recognise shapes, colours, and other structures. If we are able to write a text it is because we have taken our skills further in order to produce something.

Altamisa's case is an example about how complex it is to develop a project, and it allows us to demonstrate that we can analyse the case from different points of view. Every different point of view makes the piece open, this allows us to have a better comprehend about our production processes.

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8.APPENDICES

Altamisa's full project, files and videos: http://andamio.in/altamisa