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Michelle Agnes Magalhaes, Benjamin Matuszewski, Frédéric Bevilacqua

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¹ STARTS Residency Public Report Constella(c)tions

Michelle Agnes Magalhaes, Benjamin Matuszewski and Frédéric Bevilacqua

Abstract - The goal of the *Constella(c)tions* project was to develop new paradigms for screenless and collective musical interaction, repurposing web and mobile technologies. *Constella(c)tions* unfolds as a set of collective musical games and interactive pieces involving various gestures, body movements and action of performers and/or public within open musical environments (*open work*). The project is inscribed in a practice-based methodology with the aim of exploring and developing further technological tools dedicated to play sounds using the motion sensors embedded in smartphones. In this context, the residency allowed the composer to create new musical pieces, involving various performers, from professional music ensemble to pedagogical action in schools, as well as including the general public in performances. Feedback and continued discussions and experimentations allowed us to constantly and reflectively revise both the interaction design and technology. The gained experience ultimately allowed us to design a new version of our technological ecosystem. The results are thus intrinsically of a hybrid nature, beyond strict scientific and artistic boundaries, and allowed us to reconsider our technical setup from a novel epistemic point of view. Several new projects have already been engaged, with dancers, musicians, as well as pedagogical actions. The project allowed us to create novel ways to engage the public, aiming at fostering social interaction and inclusion.

Index Terms—Collective Interaction, Music Composition, Mobile Technologies, Movement, Music, Performances, Sensors.

I. INTRODUCTION

The *Constella(c)tions* project was proposed by composer Michelle Agnes Magalhaes in response to the third STARTS residency call. The residence proposal was to experiment with collective musical interactions, using gestures and bodily actions. The composer's artistic vision was of shifting towards novel paradigms for musical composition and scores through a series of collective “games” whose rules implied texts, visuals, objects in spaces.

This was matching particularly well with the web-based ecosystem that IRCAM has developed to create embodied collective interaction with media, and particularly with sound and music. In particular, the IRCAM project called *BeCoMe* was precisely to further develop the technological environment to support artistic use cases of collective

¹Report, February 28, 2020. This work was supported in part by the European Commission through the Coordination and Support Action VERTIGO STARTS Residencies: “Adding socio-economic value to industry through the integration of artists in research and open innovation processes.” under EC Grant 732112 We acknowledge additional support from the BeCoMe project (Ircam) and ANR Element (ANR-18-CE33-0002). Michelle Agnes Magalhaes is an invited composer, with IRCAM- Centre Pompidou, Paris France (e-mail: michelleagness@gmail.com). Benjamin Matuszewski is with the *Sound Music Movement Interaction* team, STMS Lab, IRCAM - CNRS - Sorbonne Université, Paris France (e-mail: Benjamin.Matuszewski@ircam.fr). Frederic Bevilacqua s with the *Sound Music Movement Interaction* team, STMS Lab, IRCAM - CNRS - Sorbonne Université, Paris France (e-mail: Frederic.Bevilacqua@ircam.fr).

interaction^{2,3}. Among our research questions was: how to support and/or question human/human interaction through the mediation of smartphones and web technologies.

This use of technology seeks to find an alternative between high-tech and low-tech approaches, by building on top of consumer grade and widely spread technologies, an approach we might call *everyday-tech* or “*mid-tech*”. As such, the project aims at proposing novel artistic and expressive paths that enable to include the audience by hijacking tools they are familiar with, and expose the *bricolage*⁴ of the scientific, technologic and artistic research to better blend the audience, context and artwork.

Therefore, in *Constella(c)tions*, the main tool for playing sounds is the motion sensors embedded in smartphones, which are manipulated by the public and by the performers. They permit to trigger and modify sounds according to body gestures and movements. The performance is built from the coexistence between the performers, composer and creators, musician-researcher and audience. The scenography, architecture, stage and musical space are designed as a continuum, as a set of connections between objects and people, that have musical roles through motion detectors.

II. ARTWORK

Constella(c)tions are a set of interactive music pieces. Each work is presented as a collective musical game, which unfolds as a set of interactions involving various gestures, body movements and action of performers and/or public within a composed musical environment. Mobile technologies, such as smartphones, are used to capture and play sounds. *Constella(c)tions* has been developed from different encounters between composer Michelle Agnes Magalhaes and various artists, performers, musicians as well as with researchers from the *Interaction Sound Music Movement* team at IRCAM-STMS.

An important encounter is the one, several years ago, of Michelle Agnes Magalhaes and theater director, actress and teacher Juliana Jardim, where they participated together in the creation of *The Accordion Experience*, based on *Das Badener Lehrstücke von Einverständnis* by Bertolt Brecht, as stage and music performers, respectively, with Dedé Pacheco, Maria Tendlau and Magali Biff. From 2008 to 2019, Juliana wrote and directed her project called *Ignorant essays* (www.ensaioignorantes.com), which served as conceptual foundation for developing *Constella(c)tions*. Associated with the idea of emancipating the person as developed by Joseph Jacotot (1770-1840) and reported in *Le maître ignorant* by Jacques Rancière (1987), *Ignorant essays* involved collective actions through readings, digressions, scenes, movies, songs, in a setting between the scene and the class. Together, they imagined a space for discovery and collective musical creation, which led to one of the *Constella(c)tions* pieces presented at *Centquatre-Paris*, where, guided by the performers, the public is invited to discover score elements (drawings, instructions, texts, images, actions) intended for all, without prior musical knowledge.

This piece involved *SoundInitiative*, a new music ensemble dedicated to the interpretation of contemporary repertoire in close collaboration with composers to create new pieces, and in the development of musical events with a strong emphasis on scenography. From the beginning of the *Constella(c)tions* residency, the *SoundInitiative* musicians were involved to experiment with the early prototypes, and participated in the development of a series of pieces and public events. The idea of Michelle Agnes Magalhaes to build musical composition as the interaction between score elements built as a set of texts, instructions, objects, considering the different performances space characteristic, fully resonated with the musicians' approach.

In order to fully understand how the *Constella(c)tions* artworks have been developed, we summarize below the different artistic pieces and events that happen during the residency.

² Benjamin Matuszewski, Norbert Schnell, Frédéric Bevilacqua. *Interaction Topologies in Mobile-Based Situated Networked Music Systems*. Wireless Communications and Mobile Computing, Hindawi Publishing Corporation, 2019, 2019

³ Benjamin Matuszewski, Joseph Larralde, Frédéric Bevilacqua. *Designing Movement Driven Audio Applications Using a Web-Based Interactive Machine Learning Toolkit*. Web Audio Conference (WAC), Sep 2018, Berlin, Germany.

⁴ Claude Levi-Strauss, *La pensée sauvage*, 1962

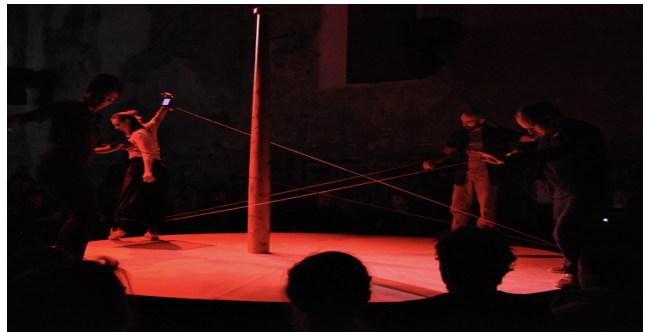
- *Mova Lab Days, Nantes (France), April 2019, (http://www.mova.one/nantes_meeting.html)*

During this workshop hosted by the *Stereolux Arts and Technology Laboratory*, two pieces were publicly shown: *Extensio* and *Two Speeds* (shown on the left), with Yves Canbdau, Sarah Fdili Alaoui and Bertha Bermudez. These musical pieces are played collectively following a set of textual instructions. The sounds is activated through the movement using smartphones attached to the wrists. These first performances represented an important step, both artistically and technologically. It also validated the technical setup as means to mediate the musical collective interactions.



- *'Première de couverture" evening, Centre les Recollet, Paris (France), June 2019.*

Constella(c)tions was performed by Maussane Lerer, Lola Malique, Lucas Struna and Ronan Gil. Here, the use of objects in the performance has been first experimented: strings were held by the performers, creating visual links between them. The strings roles were both metaphorical and evolving constraints for the performers, enabling them to find original actions and movements. A different set of sounds were specifically composed for this piece, enriching the available musical environments.



- *TRANSIENTS Festival, New York, September 2019*

This performance developed further the use of strings to create original interaction by investigating their potential as a collective instrument. These aspects were developed together with the *Soundinitative* ensemble through a week-long workshop. The smartphones attached to the string of the performer create an evolving sound environment.



- *Improtech 2019, Athens, September 2019 (ikPA'19)*

The performance was part of a festival on musical improvisation in interaction with digital systems, held at the *Cultural Center Onassis STEGI*, and the *University of Athens*.

Here, the focus has been put on how the strings, attached to smartphones, can be used for structuring spatially and dynamically the performance space from an "architectural" point of view: the strings were unfold progressively and attached between the piano and the public.



○ *Studio 5 en direct, IRCAM, December 14 2019*

The concert involved public participation with the help of the *Soundinitiative* music ensemble. This performance enabled to blend the different aspects previously developed in a public space at IRCAM normally not devoted to performances, as well as to fully integrate the participation of the public. The performance followed presentations to explain the different aspects of the collaborations of the residency.



○ *STARTS Residencies Days, Centquatre-Paris, February 28 and 29, 2020*

This performance, conceived as a series of small sound games, was also created with the musical ensemble *SoundInitiative* and featured Juliana Jardim as writer and theatrical director. It allowed us to further refine and develop the scenography and the audience participation scenarios. Indeed, the public could be close to the performance space and actively participate in the games led by the professional performers.



III. METHODOLOGY

The methodology used in this project can be best described as practice-based research. From a global perspective, the methodology was to develop prototypes and short musical pieces, through rapid iteration cycles. Each cycle allowed us to experiment with specific interaction principles and sonic results. Both technological adjustments of the prototypes and musical ideas were then tested conjointly. The series of public events allowed for assessing the different options, and critically reviewed the system. In addition to the performances described in the previous section, other workshops allowed us to experiment with the concepts and technology. In particular, several workshops with musical students were held at *Conservatoire of Saint-Brice sous Forêt*.

The main objective of the project is to explore further how to control sound synthesis and generate musical content from users' gestures, and more specifically how such an approach can be implemented in collective and participatory settings. This research is based on *CoMo-Elements*^{5,6}, a template application designed toward non-developer users for gesture-based and distributed User-Centered Machine Learning⁷. As such, the application is specifically designed to provide an environment where users without expert programming knowledge can create their own instance of the application (e.g. behavior and mappings of different clients) by simply editing a configuration file.

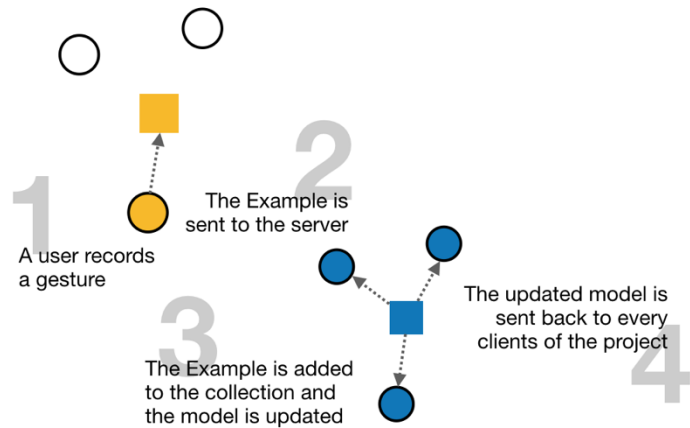
⁵ Benjamin Matuszewski, Joseph Larralde, Frédéric Bevilacqua. Designing Movement Driven Audio Applications Using a Web-Based Interactive Machine Learning Toolkit. Web Audio Conference (WAC), Sep 2018, Berlin, Germany.

⁶ <https://github.com/ircam-cosima/elements>

⁷ Marco Gillies et al.. (2016, May). Human-centred machine learning. In Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems (pp. 3558-3565).



Controller interface of the CoMo application



Typical workflow of the CoMo application

The figure above shows the generic workflow proposed by the application:

- A client records a new gesture example.
- The example is sent to the server to be added to the common training set.
- The model is updated according to the new training set.
- The new trained model is sent to all clients of the same project.
- Every client can make use of this new gesture.

The centralized state of the project on the server thus enables the automatic sharing of the gesture models among web clients, allowing for creating a large set of collective interaction scenarios.

Constella(c)tions is built on top of this application and retroactively permitted many improvements, finally leading to its complete refactoring⁸. The final work results from a number of smaller musical pieces (cf. Section Artwork) that have all been tested publicly. These public tests had a strong importance in this project in that they served several goals: assessing technical elements and improvements, but also and mainly exploring multiple ways of interacting with the public and with performers.

IV. CO-CREATION PROCESS

In this work, the artistic and techno-scientific endeavors were intimately related, following a process that could be described as: the experimental tasks were performed altogether, leading to specific tasks each different authors performed specifically, such as sound design and composition, specific developments, or testing. Also, while the performances benefited from IRCAM support, all the authors were directly involved in communication and production tasks. Despite that such involvement is beyond what is generally considered for scientific researchers, this was perceived by all stakeholders as beneficial, since it allowed all the authors to test first hand and reflect on all the process. This also contributed to the creation and sharing of a common language and understanding of technological, scientific and creative issues and processes.

V. IMPACT

This project allowed us to develop and evaluate a number of different concrete actions, from music pedagogy to artistic works implying audience participation. Importantly, as described in Section VII, these different actions will be

⁸ <https://github.com/ircam-ismm/como>

intensively pursued beyond the STARTS residency, which lead us to foresee high societal impact on the long term. The scenarios developed in various music classes (conservatory children class and choirs) offer a complementary approach to current teaching approaches, by implying corporal and collective engagement of the students in a playful manner. This opens opportunities to develop soft skills that are considered as key for personal development beyond music education. Importantly, the pedagogical aspects can also be applied for a large range of situations and people, from amateur to professional, from children to adults. For example, a collaboration with the *Ligeti Quartet* will allow workshops with deaf children in the UK. Also, a long week workshop with professional dancers will be held with the choreographer Hervé Robbe in the context of the *Academy* of the *Manifeste Festival* in Paris.

The more detailed impacts are described below from both the research and artistic perspectives.

A. *Research Impact*

The collaboration between the ISMM team and the composer stimulated further research and several technological developments. First, it permitted us to test our prototype in real environments, showing some of their flaws and ultimately allowing for making it more robust. Second, it enabled us to test its limits, both technically and in its usability, triggering improvements in form of new software developments and prototyping extensions. Third, it permitted us to reflect upon and enlarge the conceptual background thanks to the confrontation to new conceptual and musical ideas and practices.

These three axes of research and developments were all conducted parallelly in two highly demanding, while very different, contexts. On the one hand, the multiple performance situations allowed us to focus on particular requirements such as robustness, easiness of deployment, controllability. On the other hand, the context of compositional process and elaboration in the studio permitted to focus on aspects such as flexibility, testability and adaptability. Ultimately, the collaboration contributed in large parts to the formalization, design and development of a novel version of our tool (<https://github.com/ircam-ismm/como>), hopefully unfolding new paths for scientific, design and artistic research.

B. *Artistic Impact*

From a formal point of view, the collaboration challenged the composer Michelle Agnes Magalhaes to expand her practices of musical composition. This led her to conceive novel musical forms: she oriented the composition process towards open-work, conceiving her compositions as “interactive puzzle”. Moreover, the project led the composer to develop a holistic approach of sound-action interaction, avoiding to consider gesture, movement and sound as separate elements as often found in digital practices. This enabled the composer to create a coherent and personal interactive sound environment, through an iterative process of samples recording and testing both in studio and in real-world situations.

Finally, the project already led to new artistic collaborations with different artists, and will be shown internationally in the following years. As already mentioned, the project led (in less than a year) to six public performances in Europe and the US.

VI. ART-SCIENCE INTER-RELATIONSHIPS

Our project was precisely to further develop both artistic, user interactions and technological aspects. Among our research questions was how to support and/or question human/human interaction through the mediation of “screenless” devices, developing novel multimodal interaction paradigms using smartphones and web technologies. We believe that these questions can only be research in implying highly multidisciplinary approaches, with both artists, scientists and technologists.

In *Constella(c)tions*, the main tool for playing sounds are the motion sensors embedded in smartphones, which are manipulated by the public and by the performers. The musical space, scenography and stage architecture are designed as a continuum of affordances, from objects to sounds, enabling connections between the environment and the people. Therefore, the works are co-created at several levels, built from the coexistence between the artists, performers, researchers and finally, also the audience.

This collaboration is inscribed in the elaboration of a conceptual and epistemological framework we are currently

developing. This framework makes use of the concept of *experimental system* as defined by Rheinberger⁹, to overcome current issues often described in art/science relationships¹⁰. More precisely, we postulate that such an approach of experimental systems – as systems composed of *epistemic things* and *technical objects* in constant evolution and reconfiguration – is a fruitful basis in providing a common and operational ground for pluralistic research approaches and collaborations (scientific, technological and artistic), by allowing to abstract from disciplines and concurrent epistemologies. In this context, we think the *Contella(c)tions* project offered an interesting contribution and test-case in the development of this framework.

VII. FUTURE DIRECTION AND ACTIONS

Several projects and collaborations are currently pursued beyond the official end of the STARTS residency. In particular:

- Dance and choreographic work with Hervé Robbe, a week workshop at the pompidou (from 15 to 19 June) with a presentation at the end (19 June). The event is part of the programming of the *Centre National de la Danse* (Camping <https://www.cnd.fr/en/page/33-camping>) associated with the Ircam Festival (Manifesto). In all we will be a team of 5 musicians + 15 dancers + our team at Ircam. Our device will have a scenographic function with a strong visual-sound and interactive aspect.
- 2020: Workshops with the students of the Conservatory of Saint-Brice sous Forêt, with a public presentation in a large gymnasium (500 seats)
- June 13 2020, Performance with the device and the *SoundInitiative* ensemble at the Arts Centre in Enghien-les-Bains.
- For the second semester the London based *Ligeti Quartet* is offering workshops with deaf children in the UK.

The new version of CoMo will be released in 2020, with various forms: CoMo-Art (directly aimed at Music and Dance performances), CoMo-Education (in collaboration with CRI-Paris, Université de Paris), CoMo-Research for scientific studies.

VIII. CONCLUSION

The residency was judged by all parties as highly valuable, and raised motivations to pursue the project and collaborations. It validates our web-based tools, expecting then a large range of novel scientific and artistic applications. Moreover, the continuation of this collaborative work should lead to potentially high societal impacts, in creating original events implying audience participation and pedagogical actions with children and adults, and fostering inclusion.

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⁹ Rheinberger, Hans-Jörg. “Consistency from the Perspective of an Experimental Systems Approach to the Sciences and Their Epistemic Objects.” Manuscript 34, no. 1 (June 2011): 307–21.

¹⁰ Schwab, M. *Experimental Systems: Future Knowledge in Artistic Research*. Orpheus Institute Series. Leuven University Press, 2013. p. 214