Master thesis proposal

By
Arthur Parmentier

Augmenting GeKiPe: Soundpainting language recognition for sound and video synthesis

1. Context

a. GeKiPe

The HEM (Haute Ecole de Musique) of Geneva is developing with IRCAM (Institute for Research and Coordination in Acoustics/Music) a tool named GeKiPe (Geste Kinect et Percussion), a gesture-based interface for audiovisual performance by Philippe Spiesser, Thomas Penanguer, José-Miguel Fernandez and Alexander Vert.

Watch it in action or in this more explanatory (&old) video.

The research project led by Philippe Spiesser in Geneva will probably continue and cover other topics, for instance questions of gesture notation; a project is to be submitted early 2020 to the FNS linking the DCML & HEM.

b. Soundpainting (SP) & semantic gesture recognition

Explained by its creator, « Soundpainting is the universal multidisciplinary live composing sign language for musicians, actors, dancers, and visual Artists. Presently (2019) the language comprises more than 1500 gestures that are signed by the Soundpainter (composer) to indicate the type of material desired of the performers. The creation of the composition is realized, by the Soundpainter, through the parameters of each set of signed gestures. The Soundpainting language was created by Walter Thompson in Woodstock, New York in 1974. »

Recent research[1] in soundpainting and performance has shown the potential of using soundpainting not only for a frontal performance linking a composer and performers but as a

[1] For instance, take a look at Conducting with the body or similar duets, Audrey Vallarino and the Tours soundpainting orchestra, Col·lectiu Free't. Soundpainting

communication and synthesis language between the performers themselves or between the performers and machines.

A few documented attempts at using sounpainting gestures semantic recognition have been documented recently (for instance at ESTIA or Université de Toulouse; IRIT) but lack both efficiency and connection with a broader artistic material synthesis pipeline such as the one provided in GeKiPe.

c. When the stars align at EPFL

At EPFL, a small artistic collective (co-founded by myself) is born around the practice and research with the soundpainting language as part of the Musical, a commission of the AGEPoly. We organized several workshops in and outside EPFL and are taking the idea further by preparing with Constance Frei (musicologist and lecturer at EPFL) and the CdH-culture the next workshop under the ARTLab in february 2020: Soundpainting & Cinéma, inviting Walter Thompson himself.

The ARTLab is not only an exhibition or performance space but also a research lab, connected to the EM+, both directed by Sarah Kenderdine. The EM+ and ARTLab are working with advanced tools in sensors, immersive visualizations and performances which would propose a very rich context for a more advanced research on gesture recognition and sound/video synthesis.

Finally, although not investigated by me so far, the DCML at EPFL, as mentioned previously, is leading important theoretical research on musical grammars, symbolic analysis of musical pieces and notations. Not only are they thinking about working with the GeKiPe tool, but also potentially interested in the linguistic and semantical propositions of the soundpainting language as a framework for a broader theoretical construction and research.

In terms of calendar, EPFL master projects are to start mid-february, at the same time of the FNS project submission between HEM & EPFL and the soundpainting workshop given at ARTLab, which could turn into an important experimentation time for investigating the possible links between GeKiPe, soundpainting and visualization tools at ARTLab and their performativity.

Therefore, a research project linking the HEM, IRCAM, (throughout the HEM), the EM+ and DCML labs, Constance Frei and myself as part of the soundpainting collective of EPFL-UNIL appears interesting, both in terms of topics and calendar.

2. Project description (master thesis)

a. Concept

The project, conducted over 17 weeks at EPFL, starting mid-february, would consist of augmenting the GeKiPe tool with symbolic soundpainting gestures recognition algorithms, possibly using immersive visualization tools (360 panorama).

GeKiPe, developed by HEM and IRCAM, offers mechanical/motion tracking based sound and video synthesis possibilities, such as creating a whole virtual percussion instrument. The system encapsulates:

- A range of sensors (gloves and Kinect)
- A real-time sound & video synthesis module
- Protocols and communication modules between the sensors and the synthesis module

One feature that this instrument could possibly lack is the editing of the sound while the performer is playing (for instance changing the octave, volume, tempo or other parameters of the synthesis): the performer is missing interactions with the parameters of the sound module itself, so that he cannot change of instrument, type of content provided by the virtual instrument, scale or harmony.

Soundpainting however provides a whole language defining symbolic gestures that play exactly with these parameters. There is a gesture for “change”, another for “style”, another for “harmony”, “volume”, “tempo” and so on, allowing for a very efficient communication between the soundpainter and the artists who are playing (“somehow” acting as an intelligent synthesis module), producing the sounds and other artistic contents. The combination of these gestures must follow a specific grammar which makes possible the understanding of complex instructions between the communicants. The most important rule at the basis of the soundpainting grammar is the following:

- A statement starts with the indication of WHO is concerned by the instruction
- Followed by the indication of WHAT (content)
- Followed by the indication HOW (eg. “low volume” or “high tempo”)
- Ends with the indication WHEN (when to perform)

This simple rule is then complexified with other types of signs such as the type MODE or the implicit usage of the CONTENT “this” when only providing a HOW indication, the omitting of the WHO indication when a previous indication has been given not long before etc.

One MODE offered by the soundpainting language is called “Shapeline”. In this mode, all the gestures are interpreted as esthetic or mechanical gestures, without any symbolic interpretation. This MODE corresponds to the mechanical interpretation of the gestures offered by the GeKiPe. Therefore, we can think of the actual possibilities of the GeKiPe tool as a specific interpretation of the gestures corresponding to the “shapeline” MODE, in a wider range of interpretation possibilities offered by the soundpainting language.

b. Goals

The goal of my project would be to augment the GeKiPe tool by implementing the symbolic interpretation of a few soundpainting gestures, including the “shapeline” MODE that makes full use of the powerful mechanical recognition of the tool. This extension of the tools will be an efficient way to resolve the shortcomings that I have pointed out when introducing GeKiPe, to the imaginary extent of implementing all the soundpainting gestures and new (customized ones), building a very powerful, multi-dimensional performance tool.

At the end of my project, the performer would be able to:

- Choose between 2 or 3 virtual instruments based on the WHO gestures
- Choose between 2 or 3 different contents (eg. patterns, long tones…)
- Modify dynamically the volume, spatialization and temporality of the sounds
- Choose between 2 different WHEN indications (right now and slow entrance)
- Combine the symbolic and mechanical interpretations when using contents like “hit” or the shapeline/launch mode

c. Ideal calendar

- Week 1 (12/02/2020 to 19/02/202, soundpainting workshop): getting familiar with the GeKiPe tool and pipeline, experimenting with Kinect and available sensors. Setting up a minimal synthesis tool (both audio and video) in the context of the soundpainting workshop at Artlab
- Weeks 2, 3 & 4: reviewing literature, investigating the gestures recognition modules available (ML based) and their integration inside the GeKiPe pipeline. If needed, sensors acquisition.
- Week 4 to week 9: building a training set of SP gestures and first classifiers, trained models for one or two signs and performance assessment. If possible, collaboration with ESTIA (previous research and results on the topic).
- Week 9 to week 14: defining the soundpainting grammar with an algorithmic set of rules and implementation inside the GeKiPe pipeline. If possible, collaboration with Walter Thompson and with the whole “Soundpainting Geeks” worldwide community on this topic.
- Week 14 to week 17: performance assessment, optimization and incorporation of several additional soundpainting signs. Ending with the preparation of a small demonstrative performance.
- Optional (Final weeks): building a visual interface that allow the soundpainter/performer to edit the synthesis module dynamically (eg. picking up a specific instrument, changing a parameter…)

The project would involve the collaboration of several organizations:

- (Necessary, not confirmed) HEM (Geneva) and IRCAM for giving access to the GeKiPe tool and related documentation
- (Necessary, not confirmed) EM+ (EPFL) for giving access to sensors (Kinect, cameras, motion-tracking systems, especially the R-IoT card used in GeKiPe), helping with technical aspects of the programming and thinking the whole artistic experience
- (Confirmed) UNIL with Constance Frei, musicologist and co-organiser of the soundpainting workshop at EPFL in February for conceptual development, consulting, primary testing and general support
- (Confirmed) Soundpainting collective of the Musical (AGEPoly EPFL) for artistic support, testing and training data collection for the gesture recognition model

- (Optional, but necessary in case of refusal by EM+ lab) DCML (EPFL) for supporting the theoretical investigation the definition of the soundpainting grammar and its algorithmic implementation
- (Optional) ESTIA (French engineering school) for giving access to their soundpainting gesture recognition module and/or helping based on their own experience on its design
- (Optional) “Soundpainting Geeks” community for helping with the soundpainting grammar definition and literature review

3. Further extensions

The development of this tool would make possible several analyses that are interesting for future research.

- By capturing soundpainting sequences and their interpretation by the program, one will be able to analyze the linguistic content and grammars of the gestures that are used, should they have semantic content or not. From this data, a statistic interpretation of style and grammars in soundpainting could be inferred, moreover explicitly showing its use of non-semantic content as part of the collaborative creation process.
- Throughout the use of immersive visualization contexts, one could build a tool that makes use of panoramas and domes as a visual interface between the artists and the synthesis tools. In GeKiPe, it is clear yet that the artist has prior knowledge of the movements and gestures that will trigger a specific action. Inside a panorama, one could instead navigate into a map of artistic contents (sounds, visuals etc) and trigger dynamically the desired content; having access to a possibly huge palette of sounds, instruments and other artistic contents.
- The tool could be the basis for the study of the soundpainting generative properties and explore how this system combines and makes use implicitly of both
    - Linguistic elements (as the American Sign Language)
    - Implicit cultural representations (mapping low-high frequency/volume to coordinates, temporal spacing to visual spacing, the « style » of a gesture, strong movement for a loud stroke… making use of implicit synthesis references and processes)

4. Conclusion remarks

I think this project is rather challenging and that the ideal calendar that I presented probably omits several shortcomings or problems that can occur; failure at achieving the minimal goals that I have defined is not impossible.

But I wish at opening a way, at least giving what we call a “proof of concept” if not better, and more importantly conducting that research for a longer period, should it be at one of the interested institution or during my own artistic practice.

Being a percussionist, soundpainter and EPFL student myself, this project is to me at the meeting point of several of my interests and passions.
As the stars align at EPFL thanks to the availability of important tools and collaborations,

bridging between several areas of research, I am more than passionate about combining all these elements into a tool that has such a huge creation potential from the point of view of the artist.