

# ON ARTISTIC RESEARCH IN THE CONTEXT OF THE PROJECT EMBODIED GENERATIVE MUSIC

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## ABSTRACT

We describe an artistic research process leading to the intermedial piece *Bodyscapes* in the context of the artistic and scientific research project Embodied Generative Music, which aims at furthering the understanding of the relationship between bodily and musical expression.

## 1. INTRODUCTION

Research in Computer Music is traditionally very closely related to artistic research. For productive interdisciplinary work to evolve, it seems necessary that the involved disciplines are clearly defined and their methodologies are made explicit. Most of the different scientific disciplines participating in computer music research are quite established and can rely on a long and strong tradition. Artistic research still has a relatively weak position compared to these scientific disciplines. In describing an artistic research process in the context of a mixed artistic and scientific research project, this paper tries to contribute to the forming of artistic research as a discipline.

## 2. ARTISTIC RESEARCH

Artistic practice always includes a certain amount of research. Such research is based on the artistic methods and skills particular for each art form. The results of an artistic production process including research is usually some kind of art work, which generally is the only trace of this process. The results of the research component are normally not considered separately. The research remains internal to the artistic process – it is only carried out in order to create the art work.

This is different in *artistic research*, which aims at the production of artistic knowledge accessible to society. This knowledge can only be gained through artistic practice, but in order to communicate it, the creation process has to be accompanied by a process of reflection and documentation. Artistic research can never be separated from artistic practice, it can only happen in the context of artistic practice.

Artistic practice is essential to artistic research, but not necessarily vice versa – although one of the objectives of artistic research certainly is to inform artistic practice.

Artistic research is usually carried out in close cooperation with scientific research. This is due to the interdisciplinary nature of the research topics typical for artistic research, an example of which is presented in this paper. On the methodological level artistic research is – as much as scientific research – required to intersubjectively reflect and document the research process and its results in a lasting way in order to make it available for future discourse. The relationship between artistic practice and research has been very concisely described by Henk Borgdorff in [1].

This paper is an attempt in documenting the artistic research process linked to the creation of the dance solo piece *Bodyscapes*, an interdisciplinary (dance and computer music) artistic experiment carried out in the *aesthetic laboratory* (c.f. section 3.1) of the research project described next.

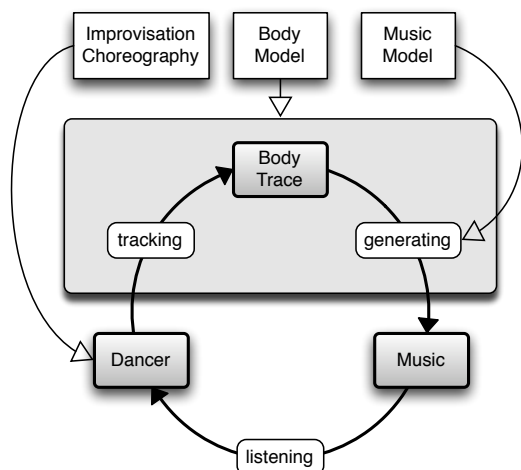
## 3. EMBODIED GENERATIVE MUSIC

The Embodied Generative Music<sup>1</sup> (EGM) project combines scientific and artistic research in order to further the understanding of the relationship between bodily and musical expression. The research in EGM is driven by a scientific and an artistic motivation.

On the scientific side, the questions concerning the role of the body in music creation, performance, and experience are approached from the perspective of music aesthetics. It is common sense that there exists a close relationship between the two forms of expression, one of which usually appeals more to the visual sense (literal body movement) whereas the other one more to the auditory (metaphorical movement in music). The main scientific objective of the project is to elucidate bodily – as different from intellectual – aspects in musical experience and thus to propose new elements of an aesthetic theory of the body/music relationship.

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**Figure 1.** Schema of the ÆLab Setup

On the artistic side, the body/music relationship is approached from a poietic perspective in the context of performance-oriented computer music [2]. A main characteristic of this kind of computer music is the possibility to dissociate the performer movement from the sound production and make it thus subject to composition. The EGM project aims at contributing to the sharpening of the questions associated with the poietic conditions of computer music production. Of central concern is the question through which means and to which extent performers (especially dancers) may be able to shape the unfolding of a generative music composition through and with their bodies.

### 3.1. Æsthetic Laboratory

The *æsthetic laboratory* (ÆLab) is the research environment in which the EGM project is carried out. Physically it is installed in a 120 m<sup>2</sup> studio space equipped with a 24-channel hemispherical Ambisonics-based sound projection system, which is complemented by an array of 48 ceiling-mounted speakers. Besides the sound projection and rendering infrastructure, a 56 m<sup>2</sup> dance floor and a VICON motion-capture system with 15 infrared cameras is installed allowing for high-quality full-body motion tracking.

Working in the ÆLab, the dancer leaves a complex “body trace” in time and space which is used to inform the generation of the music (see Figure 1). The “body model” is inherent to the tracking technology used (see Figure 2). The “music model” represents the generative music composition. The resulting music naturally has a strong effect on the dance. In this tightly-closed loop, the dance is as much subject to the structure of a choreography and/or the dancers’ improvisational skills as it is driven by the music unfolding as a consequence of the dancers’ movements – i.e. a music the dancers perform themselves.

The understanding of embodiment in the context of the

EGM project is that of an extension of the dancer’s body into the music – both on the level of the sound production as well as on the level of the unfolding of the compositional structure. With respect to the sound production – on which *Bodyscapes*<sup>2</sup> focuses – EGM offers the dancer a kind of virtual instrument. For the dancer to be able to “inhabit” the instrument (c.f. section 4), a number of requirements have to be met, some of which were assumed essential at the outset of the project, others were identified during the course of the project.

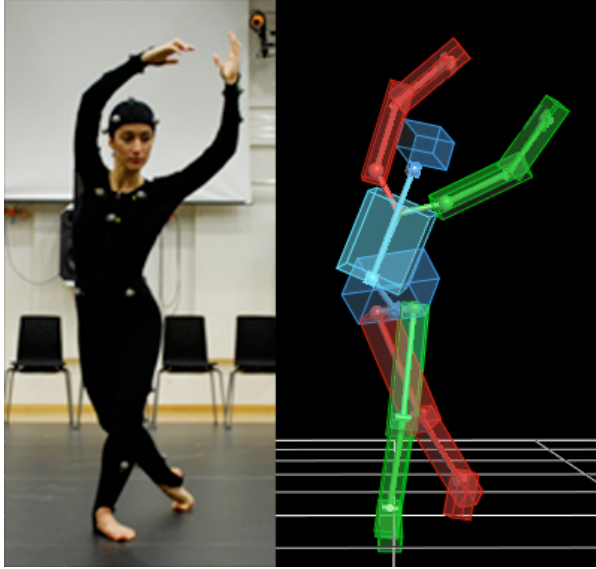
Richard F. Moore’s term “control intimacy” [3] denotes a concept very useful in illustrating many of the requirements that have to be met in order for an embodied sound generation to become accessible to a dancer. In his paper, Moore focuses on the temporal aspects of the problem – the time-lag between performer action and audible result and the jitter of this time-lag. Both are very important in the case of EGM – the time-lag has to be as short as possible and the jitter as small as possible. In the EGM setup we work with a time-lag of less than 20 ms from movement to sound and a jitter of no more than 5%. These values were measured with a VICON<sup>3</sup> system comprising 15 M2 cameras covering a tracking volume of about 100 m<sup>3</sup> and running the iQ2.5 software. In most cases, a tracking rate of 120 fps is used at which the position and orientation data is provided by the system. Higher rates are possible but would reduce the spatial resolution of the system, which was soon found to be essential for embodiment to occur. At 120 fps the system resolves positions with a precision of about 1 mm.

As much as we have to provide the dancer with a real-time interface, the interface is also required to qualify as a *real-space* interface. Only the mentioned spatial resolution and its consistent availability throughout the whole tracking volume can guarantee that also the most subtle movements of the dancers are captured and can be translated into sound. The noise introduced by the system described here is of the same order of magnitude than the noise inherent to a dancer’s body – this being a minimum requirement for embodiment to occur with most types of mappings, especially, of course, with space-based mappings. This aspect has been described very well by David Wessel, when he writes: “Musical control intimacy and virtuosity require both spatial and temporal precision in the sensing of gestures”[4].

Another requirement for the dancer’s movement to be kept intact is the availability of position and orientation information with the mentioned resolution for all body segments in order to allow for a sufficiently detailed and fully three-dimensional representation of the dancer’s instantaneous posture. The quality of the posture representation has to be independent of the dancer’s position and orientation in the tracking volume. The overall quality of a *real-space* in-

<sup>2</sup>URL: <http://iaem.at/projekte/egm/bodyscapes> (accessed May 9<sup>th</sup> 2009)

<sup>3</sup>URL: <http://www.vicon.com> (accessed May 9<sup>th</sup> 2009)



**Figure 2.** Valentina Moar in the full-body tracking suit (left) as being tracked by the motion tracking system (right)

terface is determined by its spatial precision, the size of the tracking volume covered, and its reliability (the system has to be able to track any posture a dancer may adopt).

#### 4. RESEARCH QUESTIONS

The overall objective of the artistic research in EGM is the development of new intermedial means of artistic expression combining dance and generative music, choreography and composition through new technology. There are a number of research questions which arise from this overall goal. The central question concerns the manner in which dancer's movement may influence the unfolding of a generative composition in an intuitive, i.e. embodied way. As we cannot imagine yet the solution to this problem, we use the word "inhabiting" to describe an essential quality of the relationship between the dancing body and a musical composition. We imagine the dancers to be able to inhabit the music (as well as their dance). By this we mean they will know it well, feel "at home" in it, they will feel at ease navigating it, they will be able to achieve a symbiosis of movement and sound, of dance and music, of choreography, improvisation and composition.

As such an endeavor will probably extend the established understanding of choreography, improvisation, and composition, we have to approach our goal step-by-step in order to tackle the complexity involved. We can formulate our problem in terms of building a new instrument that can be played by the dancer – knowing well that the terms "instrument" and "to play" serve only as auxiliary constructs, as we mean an instrument for playing on a structural level. An underlying assumption of our approach is that the ex-

pressive means as well as the bodily knowledge and memory of the dancing body are best suited to fulfill our desires of an embodied generative music.

The first step in approaching our overall objective consisted in taking our instrument metaphor literally and have the body produce sound. This is achieved by directly mapping the tracking data to sound synthesis parameters, thus achieving a kind of sonification of the dancers movements. After a period of exploring various kinds of motion-to-sound mappings with different dancers, we summarized our findings in a short dance solo piece, which became *Bodyscapes*. The decision to produce a piece and also perform it was methodologically motivated. There is a big difference to an experiment in a laboratory situation, in which we may abstract from many aspects which are part of the problem we are treating in order to concentrate on a few central ones. When producing a piece that follows an artistic idea, we are forced to acknowledge all aspects of the production and performance and this will raise different questions, which otherwise would never be asked and answered.

With *Bodyscapes* we posed a question simple enough in order to be answered in a short artistic production cycle. The question was, which are the most fundamental ways of linking bodily movement and sound and how can they be used to relate dance and music in new ways. Each answer given in the piece appears as a space of possible relationships between movement and sound (a bodyscape), every one bearing a particular recognizable characteristic and aesthetic identity.

#### 5. RESEARCH METHODS

The described research questions were investigated in an artistic process using the methods put forward next. We concentrate on two types, a discursive and an aesthetic one.

##### 5.1. Discursive Means

Prior to the first working period, the artistic ideas were described in a text by the composers (Eckel and Pirrò) and communicated to the choreographer and dancer (Valentina Moar). This first step was required for establishing the basis for the interdisciplinary discourse about the work in the team. At the same time, the textual description of the artistic ideas is a methodological necessity. Even if it can never capture all aspects of the artistic ideas involved, it is a tool to reflect and communicate about them. Based on the textual description, a first choice of sound models and motion mappings have been prepared by the composers. This choice was based on the experiences made with other dancers in the ÆLab. The first work meeting started with a discussion based on the descriptive text.

Finding a common vocabulary helped shaping and further developing the artistic ideas. A bodyscape was dis-

cussed in terms of four aspects: (1) the artistic idea driving its composition, (2) a sound model developed according to the artistic idea, (3) an empirically determined motion mapping connecting sound variation to bodily movement, and (4) the dynamics induced in the dancer's body by the behavior of the resulting sound.

The understanding was reached that a bodyscape can be thought of as a kind of "sound costume". In this sense, a successfully composed bodyscape has to be "wearable" by the dancer. Wearing the sound costume will – similar to a real costume – highlight certain features of the movement and it will suggest to move in certain ways, to use the sound-extended body in a certain way. It may also constrain the movement strongly, which may (or not) suit the artistic idea.

## 5.2. Aesthetic Means

The elaboration of each bodyscape followed a similar scheme closely related to the four aspects mentioned above. The description of the artistic idea was the basis for choosing a sound model and determining the appropriateness of the mapping. Dancers can judge with high confidence if a sound model and its motion mapping fit the movement or not, i.e. if the change in the sound feels right for a particular movement with respect to realizing a particular artistic idea. The motion mappings were developed in several iterations of an empirical process, in which dancer and composers informally assessed and discussed the quality of the mapping using their own embodied perception. The main measurement instrument in the AELab is thus the aesthetic experience of the artistic researchers – hence the name of our lab. This experience, which is discussed among the researchers, is the basis for the aesthetic judgment that determines the path the process takes.

## 6. EXAMPLE

In order to illustrate our approach, we now describe one detail of creating *Bodyscapes* in some depth. It concerns the way we determined the motion mappings. We take the first bodyscape as an example. Following the underlying artistic idea, we defined the quality of the desired body/sound dynamic as one that follows as closely as possible the bodily effort involved in performing the movement. While experimenting with simple *ad hoc* mappings from our library, we learned that this quality can be approached if the sound caused by the movement does not suggest any kind of resistance. This we learned through aesthetic observation and judgement of unsuccessful examples, allowing us to sharpen our ideas.

Essentially, the empirical process of establishing the mapping is a classical trial-and-error process, which is informed by all prior experiences gathered in the AELab so far. Another important ingredient of the process is our software

environment, which allows for rapid prototyping of complex mappings involving tracking data processing based on a library of analysis and conditioning modules. The possibility to quickly react to the aesthetic experience by either fine-tuning or completely changing a mapping is essential to advance efficiently in a trial-and-error search, making productive use of our short-term memory.

The determining factors in the example described are the aesthetic experience of the dancer and composers in the process and the aesthetic judgement based on this experience in view of the artistic idea. This also highlights another important aspect of artistic research: since an artistic idea can never be fully described and will always remain implicit in a production process, the only way to decide if the process evolves in the desired direction is to test intermediate results and judge if they are in line with the artistic idea or not.

## 7. CONCLUSIONS

The main result of the artistic research efforts described in this paper can be seen in the establishment of a method allowing to gain access to dance performers' implicit bodily knowledge about the aptness of movement/sound relationships. By composing virtual instruments in the framework of the EGM AELab allowing to realize particular body/sound relationships, we manage to render certain aspects of this knowledge explicit through sound. The collaborative composition of such a mapping is a tedious empirical process paved with failures and frustrations. This process has met its objective only once the result *feels right* for the dancer (and the observer). Once the sound generation is felt to be embodied and the dancers can fully engage with the sound, they report a heightened awareness of the details of their movement. This also opens new possibilities for the choreographic work as structural aspects may become audible.

## 8. REFERENCES

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