Towards an Aesthetic of Hybrid Performance Practice: Incorporating Motion Tracking, Gestural and Telematic Techniques in Audiovisual Performance

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Abstract. This paper discusses composing works for interactive live performance based on the comparison between recent artworks and experimental work methods of the two authors. We compare the different interaction design strategies employed and discuss the factors which influenced the choice of methods for motion tracking and their influence on body movements when coupled with the generation of sound during the performance. We consider the resulting artworks as hybrid artforms that combine aspects of music composition, improvised sound performance, and stage performance or dance. A high-level comparison of the technical and practical aspects of said works is provided. It can be argued that the new expressive potential and the wealth of possibilities to be explored warrants further work in this direction, and that systematic comparison of the interactive characteristics and expressive affordances of the systems developed are useful in guiding further research in the development of novel hybrid performance forms.

Keywords: Interactive Music Performance, Audio-Visual Art, Gesture Mapping, Telematic Art, Embodied Performance

1 Introduction

In acoustic music performance we can say that the actions or gestures of performers also provide visual cues conveying the character and shape of sound. At the same time, a performer's actions or gestures are directly coupled to the characteristics of produced sound and its musical expressive characteristics. Overall, we can say that instrumental music performance is a form of multimodal interaction synthesis [1].

The shapes of performer's gestures are dictated to a large extent by the physical properties of the instrument they are using, and appropriate techniques of performance are required to play it functionally and effectively. In addition, performers' intentions with regard to musical expression influence the form of characteristic gesture shapes. Therefore, acoustic music performance creates a fairly strict framework within which performers must stay in order to interact with their instruments in a musically effective way. The actual shape of gestures is usually regarded as playing an auxiliary role in the experience of the performance.

However, in the context of interactive computer music composition we can create new relationships between performance gestures and sound and we can choose more freely both the types of movements and the degree and type of their influence on the resulting sound. This leaves greater margins of freedom to explore the expressive potential of performance gestures from the viewpoint of their visual expressive impact. This leads to a hybrid form of expressive art that lies between visual art and music or other types of stage performance.

This paper discusses composing works for interactive live performance based on the comparison between recent artworks and experimental work methods of the two authors. The works are: *People in the Dunes,* [2] and [3] created by Haruka Hirayama in collaboration with a visual artist and choreographer Bettina Hoffmann, and *IDE-Fantasy*, created by Iannis Zannos in collaboration with dancers Jun Takahashi and Asayo Hisai (Japan) and Tasos Pappas-Petrides, Vasiliki Florou, Natali Mandila and Mary Randou (Greece) [4].

We compare the different interaction design strategies employed in the above works and discuss the factors which influenced the choice of methods for motion tracking and their influence on body movements during the performance, when directly coupled with the generation of sound during the performance. We consider the resulting artworks as hybrid art forms that combine aspects of music composition, improvised sound performance, and stage performance or dance. We discuss the degree to which system design allowing dancers to develop their individual or intuitive style of performance, with reference to the affordances created by the technical characteristics of the systems employed. Several unresolved problems arise with regard to both performance practice and the aesthetic appreciation of such works.

The extent of possible couplings of body movement to sound forms is vast, and the task of choosing or designing interaction strategies is daunting. This problem is furthermore compounded by technical limits in the accuracy and response time of movement tracking devices and by the complex, at times almost entirely unpredictable behaviour of the couplings between movement and the resulting sounds, both in terms of the physical or mathematical behaviour and from the perceptual viewpoint. However, we argue that the new expressive potential and the amount of possibilities to be explored warrants further work in this direction, and that systematic comparison of the interactive characteristics and expressive affordances of the systems developed are useful in guiding further research in the development of novel hybrid performance forms. The present paper presents a simple methodology based on a classification of the interaction techniques used in the works mentioned, and evaluating their potential based on practical factors experienced during our work.

2 The Performances

2.1 *People in the Dunes*

The *People in the Dunes* project explores expressive potential of performance with real-time sound processing as a live audio-visual art that exists at the intersection of interactive music performance and visual art involving human bodies. In this work, human

body movement plays a theatrical role while at the same time working as a medium for sound conveyance and a form of music embodiment in a manner similar to instrumental performance in music.

The *People in the Dunes* project consists of three works: *People in the Dunes I*, *The Embodiment I - Strings*, and *People in the Dunes II*. These have been created and performed in Tokyo, Montreal, and Gatineau in Canada between 2018 and 2020. The title of the project is inspired by the novel *The Woman in the Dunes* by Kobo Abe, that depicts the situation of a man trapped in the dunes fighting the ever flowing sand, reflecting about his life and in the end becoming aware of its essence and finding freedom: how human bodies and movements eventually find new directions under the influence of the forces acting from multiple directions between multiple individual actors, particularly under restricted circumstances? This project has been further developed by involving local dancers and instrumentalits working in Butoh and other contemporary styles.

2.2 *IDE-Fantasy*

The objective of *IDE-Fantasy* is to create an interactive performance which can be realized in remote locations at the same time, through the collaboration of dancers in each location, and relying entirely on motion capture data from the dancers. The piece eschews any transmission of images or sounds between the locations of the performances. The presence of the performers is transmitted between the remote stages of the performances based solely on the influence of their tracked movements on the sounds which are produced locally at each stage. Both the performers and the audience must rely on the sounds locally created by sound synthesis software to reconstruct in their imagination the actions or states of the performers in remote locations. The objective is to explore the narrative and interpretive potential of strictly reduced means for representation and the capability for sensing the states and of the performers based on the data traces left by their body movements, but without having direct visual or auditory contact.

The subject matter of the performance is inspired by the story of *Izutsu*, a Japanese Noh Play, which talks of the encounter of a monk with the ghost of a woman that is longing for reunion with her lover and husband from her previous life. Additionally, as a cultural reflection of the idea of correspondences between remote locations, symbolic correspondences between *Izutsu* and the myths of *Echo and Narcissus* and of *Daphnis and Chloe* are being explored for future realisations of this work.

The piece was developed through a series of rehearsals in Tokyo, Athens and Corfu. So far, telematic rehearsals have been realised between Athens and Corfu and Athens and Jerusalem. A performance between Stanford (USA), Athens and Corfu was presented in March 2019 at the LAC19 conference. This performance was combined with a presentation of the software framework used to create the piece [5]. A local only performance was presented at TAMA Music Festival in 2020. Further realisations are being prepared in conjunction with ongoing rehearsals and the development of new techniques for data capture and transmission.

3 Methodolody, Design Considerations, Discussion

From the perspective of an interactive music composer, the following research questions are addressed in both projects discussed: What are the expressive possibilities of music composition motivated by performance gestures? What is the theoretical framework required to create links between the shape formed by human bodies and sound, and between changes of shapes and sound transformations? Also, what are the technical means for linking physical body movement to sound production, and how can these influence the artistic process and its final outcome?

In the case of *People in the Dunes*, the experience of the composer's previous work *FRISKOTO* raised questions about the difference between performance gestures and control gestures in music. The hypothesis was posed, that the difference consists in the possibility of perceiving gestures as the animating force of music or not [1]. To make bodily movement perceivable as an animating force of music it is important to develop a system where sound can give an instant reaction to the movement, and vice versa. Furthermore, it is important to consider the correspondences between visual and auditory percepts. Visual and auditory sensations need to be properly coordinated or corresponded, in other words, their correspondences should be readily recognizable to performers as well as viewers. The following aspects guided the creative process and the design of the performances as a whole:

1. The availability of movement capture technologies and their technical performance characteristics (accuracy, reliability, temporal and measuring resolution, latency);
2. Affordances of the movement tracking devices for the performers (which movements are easy and comfortable for the performers to execute while using the tracking devices, and how do they understand the relationship between their movements and the resulting data when using the device);
3. Design of the mechanisms for influencing the sound produced based on the data received from the tracking devices;
4. Correspondence of the perceptual characteristics of the available or chosen sonic vocabulary to those of the gestural vocabulary developed by the performers;
5. Narrative effects of the sequential ordering of sequence of motions types and associated sound textures. The alternation of different motion types and types of sound textures produced by these can provide cues to the audience for understanding the causal relationship between movements and sounds, and thus aid their understanding of or identification with the performance. In addition, the ordering of motion types and sound textures can form a type of sequence of scenes that create the impression of a narrative, albeit of a fairly abstract and vague type. This plays an important role in capturing the attention of the audience, by offering hints for fabricating an interpretation of the events of the performance in their own imagination;
6. Subtle changes and minimalism. At certain parts of the performance, it is helpful to heighten the sensibility and awareness of the audience by purposely focusing on minute movements or changes of sound. This can intensify the sense of tension and the interpretive potential of the piece.

In the development of *IDE-Fantasy* we started with simple mappings between movement and synthesis parameters as few as 1 or 2, and gradually introduced more param-

eters. Even extremely simple parameter - sound mappings proved to be useful performance tools for dancers, providing them with instruments which they could explore very easily, but where nevertheless rich and responsive enough for short improvisations. In this approach, 3 or 4 parameters were already sensed as being hardly possible to handle or adapt to. 6 parameters per person were definitely outside the realm of feasible. We also experimented with 6-parameter chaotic algorithms cojointly performed by two dancers. These did capture the attention of the performers, even though they proved to be difficult to master. In table (1) we summarise the techniques used in our works.

	People in the Dunes I	*People in the Dunes II*	*IDE-Fantasy*
1. Movement tracking device	Kinect	Built-in sensors of iPhone	a) 9-axis movement b) 3-axis accelerometers
2. Number of attached sensors per person	-	2 iPhones per person	Up to 2 per person
3. Sensor positioning	-	Left and right lower arms	Wrists
4. Tracking information	Horizontal boundary position	Acceleration, Magnetic field, Gyroscope	Acceleration, Magnetic field, Gyroscope
5. Data transmission protocol	USB	WiFi	WiFi, Xbee Mesh Network
6. Software(s) for interactive systems	Max, Jitter	Max, ZIGSIM (iOS)	SuperCollider
7. Audio source for composition	a) Boundary microphones b) Prerecorded voice sound	Prerecorded voice, cello, traffic, environmental sound, synthesisers	a) Prerecorded samples b) Simple or Complex UnitGenerator graphs with or without feedback

Table 1. Technologies used in *People in the Dunes* and *IDE Fantasy*

4 Conclusion, Future Work

In all, a common trait observable in both works discussed here is the use of the technical affordances of motion tracking devices and sound generation or processing algorithms to design a sort of performance language which combines body movements and their assigned sound textures or events to create narratives of a more or less abstract type. In both pieces, concrete narratives of previously existing and well known works provided a reference framework in order to create the more abstract narrative of the pieces.

In conclusion, the main challenges confronting this kind of work stem from the abstract and indirect nature of digital mediation between bodily movement and generated audiovisual stimuli. The causal relationship between movement and generated sound or video tends to be difficult to recognise. In some cases it can be entirely absent, as is when employing chaotic synthesis algorithms. To counterbalance these obstacles, it

is necessary to create interpretive or narrative links with the performers and the audience. Simple mappings and complex or chaotic correspondences both present advantages and disadvantages, and the decisive design criteria for developing a functioning performance seem to lie in semiotic domains such as the choice of sounds, images, and movements for their associative semantic charge, and the devising of narrative devices through trial and error during rehearsals. Currently we are interested in employing Machine Learning algorithms in order to devise improved methods for translating motion to sound, and in particular in experimenting with unsupervised learning and in adaptive techniques that modify their behaviour during the performance itself.

At the same time, the characteristics and affordances of motion tracking devices (shapes of sensors, kind of detecting data, mobility etc.) have a direct impact on the available movements and thereby on the kind of body movement language that the performers develop. We feel that a combination of different type of tracking method can enhance performance expression.

The body is capable of constantly adapting and changing shapes or forms [6]. We realised that there is an interdependence between isolated movements of individual parts of the body and the perception of forms created by movements of the body as a whole. This will serve as a guiding principle for the currently planned experiments for future work.

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