Beyond movement an animal, beyond an animal the sound

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***Abstract* — 'Beyond movement an animal, beyond an animal the sound' is a solo interactive dance performance about the route of an animal from birth to an unnatural death. The project experiments with the control and adjustment of musical parameters through movement. Two questions raised during this work are: in which ways are movements translated into sound? How can a single person realize dance and composition, while at the same time efficiently handling software programming? The dancer takes decisions upon the real time sound mixing and processing via a miniDV camera, which is placed on the ceiling of the stage as well as EyesWeb and SuperCollider software. Parameters extracted from video to drive the sound were the coordinates of the center of gravity of the silhouette of the dancer, the total amount of movement of the silhouette and the duration of movement or stasis of the silhouette. These drove the triggering of sound samples and the processing of these via filters, granulation, pitch shift and spectral processing. The duration of the performance varies from ten to fourteen minutes, depending on the time the moving body needs to drive through the different phases of the choreography. Handling the entire production process from sound design over software programming to choreography and performance was a challenge that resulted in an aesthetically homogeneous and finely tuned result, that takes fully into advantage the flexibility afforded by "playing" the sound via the dancer's movements. Thus "interaction" is here understood as the mutual adjustment of sound from the dancer's movement and the dancer's movement from the sound, both at the design stage and during the performance.**

I. INTRODUCTION

By interactive dance we mean here a choreography during which movement is translated into sound. To be more specific, I refer to Julie Wilson and Mark Bromwich's use of the notion of translation in this context: "By translate we mean, in this instance, to change a movement into sound… translation meaning the transformation of one language into another. (…) In other words, it does not so much translate as add to and codify with widening significances, both movement, visual and audio gestures" [1]. This project is about an interactive composition, where sound mixing and processing are driven by the movements of the dancer on stage. The moving body becomes a musical instrument and directs the evolution of the sound material during the performance. As Guy Garnett remarks about the aesthetics of interactive computer music, interaction is divided into two categories: "(1) the human performer's contribution to computer music, and (2) the computer's contribution to human performance". [2] Both of theses categories of interaction occur in the present project.

A. Some interactive dance performances

Starting with Philippa Cullen's experiments with theremin and synthesizers in the early '70s [3], a considerable number of types of software and spatial or body sensors have been used to control sound via body movement. For example, a project at the Danish Institute of Electroacoustic Music (DIEM), realized an interactive dance performance using an interface based on flex sensors attached on the dancer in conjunction with the real-time interactive environment Max (IRCAM/Opcode) [4]. Max is also used by Todd Winkler in his interactive performance pieces that employ the Very Nervous System (VNS) device by artist David Rockeby for motion tracking from video input [5], [6]. The Laboratorio di Informatica Musicale at the DIST department of the University of Genoa has developed the EyesWeb software which by using a camera as sensor, outputs data that can be used by several systems, including Max/MSP, Kyma, Pd and real time Csound [7]. The present work uses EyesWeb for video based motion tracking and SuperCollider for sound processing.

II. BASIC CONCEPT

The idea of representing an animal's course from birth to an unnatural death was born from the uneasy awareness of the total exploitation of other species by humans and the need to express this kind of personal sensibility in an artistic way. Since I had been directly involved in contemporary dance and body kinesiology for the last four years, I was moved to attempt an interactive choreography, based on a basic common element of human and animal beings: The moving and living body itself. So the plan is to present the passage from motion to immobility and vice versa, researching at the same time, on a kinesiological level, these two extreme sides of life: birth and death. The concept of an animal's course from birth to death was the origin of the initial scenario that led both the choreography and the musical composition.

III. OVERALL STRUCTURE

The piece has three parts, which flow into each other gradually and indistinctly. The animal starts in immobility and attains the most fundamental faculties, then becomes familiarized with its environment and develops its senses. As time goes by, it explores its potential for movement, and gradually enters the final stage, where it realizes that death is near. The sounds of the first part are largely unprocessed samples from recordings. Real-time sound processing is used increasingly as the piece progresses. In the design of interaction I chose both simple mappings, which tend to be immediately understood by the observer and more subtle ones, which are hardly perceptible. The gradual shift from natural to processed sound textures indicates the animal's route through several phases of its life. Intensely processed sounds prevail towards the end of the piece. The alienating timbres of processed samples convey the sense of stress experienced by the animal before its death.

The initial objective was to create a choreography that expressively controls the mixing of the sound in real time. There was a strong desire for the dancer to be able to make decisions that contribute to the realization of the composition. While the work was in progress it became more and more evident that it was also necessary for me to control the actual processing of sound timbres in real time. At that point my goal was to create processing that would match the general characteristics of the various parts of the basic scenario. Thus, the processing was chosen according to intuitive aesthetic criteria that fit the expressive and experiential qualities of which I wanted to convey at each phase of the scenario.

The activation and deactivation of audio samples, processed or in their original recorded form, is triggered solely on the basis of the dancers movements. Real time processing appears in the second and third part of the choreography. For the second part I chose a filter that morphs between two sounds by cross fading between their spectra. Since movement is the key expressive factor in this type of 'game'-performance, the second part the choreography emphasizes the passage of the animal from slow to that of more dynamic movements. The same factors guided the choice real time processing for the third and last part of the choreography. In this part, I apply to the sample of swallows sounds, algorithms which have more drastic changing or alienating effects on the original timbre (PitchShift, granular algorithms etc.). In this way, I create dynamic sound movements and slow distorted swallow screams, which in combination with the already existing sonic environment create an immediate, visceral sense of the animals sensations of striving, stress and disorientation.

IV. SOUNDS - SOUND DESIGN

Three recorded sound samples were chosen as basis for the music composition: Sea, swallows and bells. All of these remind me of Corfu where I attended the postgraduate program in Arts and Technologies of Sound. Moreover, these three sounds offer a rich spectral content are suitable for the creation of rich timbres and with striking, perceptually prominent effect. For the recording of the sea waves I used relatively cheap equipment (Sharp portable minidisk recorder and SONY ECM-MS907 microphone), and for the other two the M-Audio Microtrak digital recorder and the SoundMan OKM II microphone. The choice of the raw sonic material proved to be a tough procedure. Initially, my desire was to use only one sound, preferably an animal sound. I selected the sound of swallows, but due to the high level of ambient noise in the recording it was inappropriate to be used as the unique sound source. So I gave up the idea of one unique sound and I compromised using the aforementioned three basic sounds. Processed sounds from the same source material are used, in order to obtain sounds ranging from very low to very high frequencies. Phase Vocoders making gaps in spectrum and passing bins randomly, granular algorithms, equalizers, noise reduction filters, convolution algorithms and impulse oscillators, are some of the processing units that I used. Most of the sounds that I used in the musical composition were processed through SuperCollider's processing units. Using those kinds of units resulted sounds that I couldn't achieve with any other software that I was using previously. The sounds that came out from the use of Phase Vocoders were mono, and for that reason I used typical tools in order to give them stereo perspective. The sounds were juxtaposed in such way as to allow a gradual transposition from static condition to peculiar mobility and intensive nervousness.

Another central idea in the development of the sound part of the project, was to explore the contrast between repetitive processed sounds and non-repetitive natural sounds. This contrast reflects the conflicts arising from the unnatural, abnormal situations that the animal encounters. My intention was to use natural sounds to emphasize the natural harmonic evolution of the animal after its birth during the first part of the choreography. Moreover the use of specific sounds through the transition from one part to the next was necessary for two reasons: first it gave a unique character to the crucial parts of the choreography and second it gave me clear and practical feedback during the performance about whether or not I was standing at the intended positions on stage which corresponded to the appropriate mappings. The passage from the first to the second part of the work is indicated by a denser wave-like sound than the one that I used for the first part. Following this point, natural and light or hard processed sounds are mixed, to accompany the animal as it explores its potential. The sound of an airplane taking off played back at varying speeds becomes audible during two pauses in the choreography, which indicate the transition from the second to the third part. The last part is dominated by vehement sounds, stressful distorted screaming calls of swallows and district rhythmic patterns. The last dynamic fall of the animal interrupts abruptly this sonic amalgam. The performance ends with the the sound of convolved church bells.

V. TECHNICAL EQUIPMENT

An impressive number of hardware and software technologies are available for projects that translate human body movement into sound. Axel Mulder classified motion tracking systems into inside-in, inside-out and outside-in [8]. In the first category sensor(s) and source(s) are both on the body, in the second employed sensor(s) on the body sense artificial external sources and in the third external employed sensor senses artificial source(s) or marker(s) on the body. As Mulder notices "Human movement tracking systems are systems that generate in real-time data that represent the measured human movement. In general such systems consist of the following items, some of which can be omitted, depending on the technology involved:

1 - Human
2 - Sensor(s) and/or marker(s) or source(s) + Interface-electronics (on body)
3 - Source(s) or marker(s) and/or sensor(s) + Interface-electronics (external)
4 - Computer Interface-electronics
5 - Computer
6 - Data representing the human movement.

The technical equipment used for this performance is a miniDV camera and two computers (PC and Mac). This this project falls under category 3 above. Mulder notes that "the performance of video-camera based technologies is dependent on the type of lens or the field of view of the camera. Video-camera based technologies are operational in a limited workspace only due to the field of the

camera(s). If the field of view of one camera is increased, resolution is decreased …illumination of the environment may be interfering with proper operation of the system". I had to take into consideration the particular technical constraints that follow from these two conditions (field of view of the camera and lighting), given the fact that the camera would be placed on the ceiling. Because of the fact that the rehearsals took place in a low ceiling hall it was necessary to put a wide-angle lens on the camera in order to expand its field of view and having broaden transposition potential of the moving body in space. Also, while I was experimenting with the lighting of the rehearsal hall I concluded that vertical lighting is necessary, because in this way the moving silhouette was clear enough even after the application of the strongest image filter in EyesWeb. Data from EyesWeb were transmitted wirelessly via OSC (Open Sound Control) Protocol to SuperCollider running on an Apple Macintosh. SuperCollider plays back prerecorded and preprocessed sound samples, as well as applying for the real time sound processing algorithms on the original material. The data from EyesWeb are used to activate and deactivate sound samples (mixing) and to control sound parameters in real time (processing). Dr. Iannis Zannos [9] helped me comprehend and program in SuperCollider, and carry out the project through his invaluable advice on technical and musical issues.

VI. CHOREOGRAPHY

Dancer and choreographer Thalia Ditsa played a vital role in creating, guiding and organizing the choreography. Talking about the basic concept of the project we entered the rehearsal studio, where we began working each different part of the project without music. During our meetings we had joint and personal interaction with the basic idea. We followed the steps of what Sally Banes and Noel Carroll call postmodern dance: "… the experimental reflection upon the nature and limits of dance [10]. We tried to figure out what fits better to each of the three parts of the project. What to accept and what to reject. We were working separately on each part of the choreography and many of the kinesiological choices came out by improvising, while we were searching for the movements to bridge the three parts together into a whole. When we thought that the choreography was completed we started to examine if and how it could be linked with the music composition. We realized that movement and sound create an integrated whole which is justified by the fact that both these two expressions had served a superior and concrete concept.

To convey the story of the project through dance, it was necessary to employ a vocabulary consisting of distinct and expressive body gestures. During the first part (birth) we thought that we should represent the dynamic event of the emergence of the newborn organism from the maternal body, which is why the choreography starts with an acrobatic figure. Very slow movements of the dancer, who approaches gradually the "reference" posture, follow the dynamic coming into life of the animal being. This "reference" posture is repeated during the performance and symbolizes the position where the animal feels safe (Fig. 1). The reference point also bridges the first with the second part of the project. Following that, the choreography becomes increasingly dynamic and the animal-dancer moves with greater ease.

Fig.1. Posture expressing that the animal feels safe

The transition from the second to the third part takes place between two pauses with material of similar quality but different duration. The pauses are marked by a posture that is inherently static and incompatible with walking or running (Fig. 2).

Fig.2. Pause

As it enters the final stage of the piece, the animal gradually realizes the oncoming of its death. Intense dynamic characteristics dominate at this stage of the performance. Movements become fast and repetitive, until the animal reaches the point of death, where it will fall for the last time, as if breaking down under a conflict between monotonous and intensely charged sounds. The three parts of the project have flexible time durations, a characteristic which according to Guy Garnett is inherent in interpretation as the performance of computer music [2].

VII. MAPPING

The starting point for the control of sound via body movement in the piece is the filtering of the dancers moving silhouette from the static background, via a basic processing module of EyesWeb. The silhouette is calculated in EyesWeb by filtering the moving parts of the input image from the static pre-recorded background so that black pixels represent the filtered static background and white represent the moving silhouette. On the basis of this silhouette, a large variety of features can be extracted. The choice of features for use on this piece depended on

the reliability of extraction and the effective immediacy for use by a single dancer in controlling sound parameters. The final choice of features was the following:

1. The coordinates of the silhouette's center of gravity ("tracked point").
2. The total quantity of motion of body based on the relative amount of changed pixels in each frame.
3. The relative duration of motion and stasis duration computed on the basis of the number of frames with movement (change of pixels) or stasis (no change) during a fixed interval duration from the present time point during tracking.
4. The position of the tracked point inside a predefined grid of rectangular cells dividing the video frame.

As mentioned, the most basic data element for the mapping in the piece is the "center of gravity" of the outline of the moving figure of the body. On EyesWeb, I defined the points on the visible floor which correspond to the activation and deactivation of sound file playback and of filter processes, so that by passing through these points the dancer can trigger and adjust the mixing of the basic sound material as well as of the sound processing patches. Additionally, a threshold on the measure of overall movement of the figure is used to trigger a specific sound file. Thus, the dancer can trigger audible transitions between major sections of the choreography by passing through specific points of the floor and can insert additional sound material through the intensity of body movements.

The control of subtler details of the timbre and texture of sound was mapped on other features extracted from the movement: The displacement of the silhouette along the x-y axes of the floor and the relative degrees of pause-and motion were used to control different parameters of sound processing algorithms during the second and third parts of the piece, such as a rectangular comb filter realized by spectral manipulation of the FFT, a pitch-shifting algorithm and a granular algorithm.

VIII. DISCUSSION: PERSONAL EXPERIENCES AND REMARKS

A defining characteristic of this project is the use of free software (open source), avoiding commercial software. The decision to use free software was a political one, made consciously, motivated by the need to escape from intellectual property rights and software monopolies while joining efforts for free circulation of information and knowledge. I started working using the program PD (Pure Data) for sound processing and its library GEM for image processing, even though I was aware of the difficulties due mainly to limited documentation and support of this software. The aforementioned programs are graphical programming languages like Max/MSP, but are limited in programming support functionality. This was the main reason why I did not use them for the final project. Having already rejected the user 'friendlier' Max/MSP while being interested in programming through text code, I finally chose SuperCollider and EyesWeb. As a consequence, I had to work with software known only to a small number of people in my immediate surroundings, which meant that I would have to invest a lot of personal effort to rise to the level of difficulty of the project.

The implementation strategy this work was marked by its nature of a one-man project: A single person is responsible for both the design and the carrying out of the choreography, the music and the programming. Attempting to tackle all aspects of programming by myself alone was an interesting yet devastating experience. I started out by studying simultaneously EyesWeb and SuperCollider. Subsequently, I started the design of the sound processing and choreography with the assistance of the dancer-choreographer Thalia. Last but not least, came the "composition" of the overall sound structure and the "tuning" of the real-time processing of the sounds. The long months of prior engagement with the technical foundations of the project tired me to the point of not being able to approach this new task in good spirit and clarity. It was time to collect the results of my sound processing and compose the music 'soundtrack' of the performance. However, a large portion of the energy needed for this had already been spent in other fields. In this hard situation the prior existence of a fully thought-out concept and scenario was decisive in enabling the completion of the choreography, together with the fact that I was the only one who had to decide, thus avoiding any obstacles that would occur if I had to reach a decision along with others. At this point, Dr. Zannos imparted a strong push to continue the work. My further efforts led me to compose and perform an interactive choreography, which represents the course of an animal from birth to an unnatural death. This choreography creates in real time the music composition of the performance.

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