

Sonic Choreography for Surround Sound Environments

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Abstract. A practice-based project that explores design theories of spatial music with choreographic concepts and practices. Aspects of Wave Field Synthesis and Ambisonics technologies are discussed. A production of original works for dance and music in surround sound constitutes the expected outcomes.

Keywords: movement, dance, expression, surround sound, Ambisonics, Wave Field Synthesis, choreography, perspective

1 Introduction

This paper is a presentation of the concepts and investigative ideas that constitute the foundation of an ongoing practice based PhD research entitled ‘Sonic Choreography for Surround Sound Environments’. The project explores the direct comparison of artificial sound movement generated by surround sound technologies to dance movement theories and practices. Through collaborative work with choreographers, it will favour the formulation of sonic choreographic concepts in the context of a music composition.

2 Methods

2.1 Aesthetic Research Practice Based

The whole project is an aesthetic research, it focuses on music composition and in particular on the applicability of movement qualities to sound. The aim of the research is to challenge existing practices by exploring them in full, to individuate how musical scopes could be related to sonic choreographic effects in a clear and satisfying manner. The collaboration with choreographers and dancers should work as immediate visual contrast to sound spatial design, which, if it is consistent enough, would counteract the presence of the performers in the space and the ideas of the choreographers.

2.2 Collaborative Work

The Game of Life Wave Field Synthesis (WFS) system consisting of 192 speakers [1] will be used in several sessions, to create a piece for dance and music by June 2013. As part of the project a session of three days has already taken place, and more are planned throughout the year.

At Goldsmiths University Digital Studios in London [2] two works with Ambisonics technology are planned: the first work is based on 1st Order Ambisonic [3], to be tested at the studios and in binaural, and the second for Higher Order Ambisonics (HOA) [3] for an horizontal speakers array (for which setup is yet to be found or arranged). Other institutions are considered.

The interest in developing two works for Ambisonics is due to the differences in image resolution between 1st Order Ambisonics and HOA which shall be discussed in this paper.

2.3 Interviews

This research involves contribution from many people including engineers, composers, scientists, scholars and choreographers. Carrying out interviews to gain further knowledge from those people with relevant expertise will add depth to the research and thus it is a vital part of the project. This method is in its arrangement phase.

3 Movement

A general concept of movement can be very difficult to define in many disciplines.

What type of phenomenon is movement and why does it hold such importance in the arts?

3.1 In Dance

There is an extensive literature of studies on movement, most of them written by dance practitioners. During the 1920s, Modern Dance flourished in Germany [4], and later in America and the rest of Europe. The common thread in this pioneering age is that movement speaks to the audience.

With Laban's words [5]: "Movements can be executed with differing degrees of inner participation and with greater or lesser intensity. They may be accelerated by an exaggerated desire to reach a goal or retarded by a cautious doubting attitude. The mover may be entirely concentrated on a movement and use the whole body in an act of powerful resistance, or casually employ only part of the body with delicate touch.

Thus we get different dynamic qualities. One of the basic nuances always shows clearly distinguishable mental and emotional attitudes.” [6], and more: “Some of the simplest correlations in space and expression can be described and comprehended without any knowledge of fundamental spatial laws. For instance, when a movement is accompanied by a secondary one in another part of the body in an opposite spatial direction, it can easily be understood that the secondary movement might inhibit or disturb the main movement.[...]Sometimes in this way dynamic nuances can be explained by the spatial influence of secondary movements and tensions.”[6]. Laban’s *Dynamosphere*, *Kinesphere* and *Effort* theories describe life as a stream of movements, that contains and expresses emotions.

A former Laban student, Mary Wigman, a talented artist who pioneered the *Ausdrucksanz*, stated: “Almost everything that is said about space can also be applied to energy, since energy comes from space“ [7], and “The absolute dance is independent of any literary-interpretive content: it does not represent, it is; and its effect on the spectator who is invited to experience the dancer’s experience is on a mental-motoric level, exciting and moving” [8].

Breaking away from of the “Expressive” dance movements, more recent creators like Cunningham where found describing: “Dancing provides an amplification of energy that is not provided any other way, and that’s what interests me” [9], “There is an ecstasy in dance beyond the idea of the movement being expressive of a particular emotion or meaning. There can be an exaltation in the aura that the freedom of a disciplined dancer provides, that is far beyond any literal rendition of meaning” [10]. Through these examples it appears that movement is transmitting or carrying something valuable, and transferring this valuable energy to people in the form of emotion, experience and artistic expression.

3.2 Expression

The meaning of expression is a critical topic, the sole term has been subject of many philosophical and semiotic studies. The sentence “Music is the relation between sound and intellect“ [11] contains a deep anthropological insight as it describes what is found as musical as relative to the human intellect. Stravinsky highlighted in his *Poetics of Music* [12], that music has no expression: ”in the pure state music is free speculation”, which confirms the relativity of the concept of expression and its derivation from subjective appreciations/dislike factors out of the artist control.

Research in music psychoanalysis has proven how far we are from having found stable solid notions for analysis, such as a neutral level [13] that would act as a starting point for a useful observation of musical *phenomena*. This is still missing and far from being defined, and methodologies are hence struggling to be successful.

Stravinsky again mentioned the artisan role of the composer [12], the *homo faber*, sculpting sound material, which turns the attention on skill, mastery, seen as the only real tangible thing against the relativity of expression. The reality of music is the

astounding combinations a composer can create with sounds, not what the sound means to anybody. Similarly, no matter what the expressive content of a movement could be, the mastery of it constitutes a central assessment that needs to be investigated through practice and observation.

4 Sound Movement

When the concept of movement is applied to sound, several distinctions must be made. For instance we are referring to the movement of sound within a surround sound environment, then for movement of sound it is intended the movement of a virtual source, not a movement embedded into the sound (e.g. a sound like in a recording of a park, the sudden movement of a bicycle), neither the sound wave acoustical motion. Hence it could be helpful to refer to it as artificial sound movement.

Source bonding concepts [14] refer to sound as a carrier of meaning, which is inseparable and determines our understanding of it. Issues about direction, proximity and individuality are well described in [15], and affect the way we create and experience a music composition. The way in which sound image is represented into the diffusion space is subject of accurate studies, whilst sound movement in current literature appears to be relegated in a secondary position, like a less important part of the overall sound image. Sometimes virtual sources movement practices are referred to as successful, but unsatisfying the complex and full dimension of sound reality [16]. Yet this is understood as confined in personal artistic interests, or sound material choices, which doesn't truly contradict the artistic relevance of movement of sound.

This research wants certainly to assess clarity and accuracy of the sonic image, and at the same time to observe what attracts our attention in movement, in whichever form it becomes manifest (as meaning/expression/feeling/energy/ecstasy...), and how it relates to the music discourse.

When a sound image appears in space, it is choreographically relevant: when a movement burst out, it dictates symmetry, correspondence as it is engaging the space. The connection with its content, a relation of consonance and amplification or of reduction, contradiction, exaggeration of the sound reality and material, is part of the artistic game, is how we want it to be or appear. When this connection comes to life, it's a tangible sign of the value of the existence/presence of the movement in the scene.

4.1 Decoding

The first issue is about how sound is diffused in the room. Different technologies have different approaches for rendering the spatial attributes of sound. In this research I take in consideration Wave Field Synthesis and Ambisonics, and in particular: 1st

order Ambisonic in 3D, Higher Order Ambisonics (realistically for an horizontal array only), WFS synthesis of 192 speakers setup in a 10x10 meter space.

A loudspeakers system should be designed to give a realistic, natural impression of space [16], and how it delivers this is crucial for the appreciation of movement as it is for the sound image.

All of these techniques are not flawless, and many situations affect the clear perception of sound movement, too many to be included in this paper. There is a general assumption that, if a sound image is clear, choreography possibilities are then absolute and unlimited. That is doubtful because of the presence of several perceptual artefacts in movement process itself, and moreover because the system design imposes a dominant sound projection perspective [20].

What it is here relevant to note is thus that the general rendition of sonic movement through different decoding systems may have different results, which directly affect the choreographic potential.

Ambisonics. Ambisonics technology works in different resolutions, and this affects the way we experience sound. In 1st Order Ambisonics, the listening area is very limited, emphasising the importance of a sweet spot. In HOA this tends to be reduced because many other spherical harmonics are added to increase resolution, so that they cover a wider listening area. Yet rendition of sound outside the sweet spot still introduces artefacts, that affects the scene intelligibility, and generally it is thought that the best perceptual location is to stand in the middle of the speakers perimeter [15, 17 and 19]. Because of this, questions arise on how to show dance in the listening space, and how sonic choreography could adapt to a dance in this space, given its ties with Ambisonics spherical sound projection. It appears to me there is a perspective conflict that as to be taken in consideration while composing, to be accommodated artistically. Whilst music content could be infinite and borderless, sonic choreography is more likely to be limited by and constructed around system characteristics. According to the space and technology available a specific approach should be favoured. This project is thus trying to build a sonic choreography on the 1st Order Ambisonics characteristic emphasising a centric perspective of sound projection through artistic exploration; a second experiment would be with HOA technology, that will require as well a specific strategy. The point is that a sonic choreography seems limited in its design as it responds to a perspective, and this perspective is dictated by the system used, like in a dancer the body is the limit and range of the expression.

Wavefield Synthesis. “Wave field synthesis (WFS) is a spatial sound field reproduction technique that utilizes a high number of loudspeakers to create a virtual auditory scene over a large listening area. It overcomes some of the limitations of stereophonic reproduction techniques, like e. g. the sweet-spot” [18].

This clearly puts WFS in a different context in respect to Ambisonics, and comparisons are difficult and maybe pointless: this other paper [17] it's indicative of the irreducible differences between the two systems, Ambisonics and WFS, in terms of math, limits of sound image rendition (artefacts differences), and quality of representation of the sound field.

For a dance performance with WFS, the accompanying sonic choreography is surrounding the audience, as listeners have to be inscribed into a perimeter of speakers, but no center is needed for the perception, which allows several dispositions of dancers, sounds and choreographies, including a frontal display of choreography, which resemble the more common way to experience a dance performance. Whilst WFS seems not to affect the choreographic design by an imposed perspective of sound projection, how the impression of depth is rendered has yet to be explored in the project, especially how different locations and perspectives and relation between locations of sound sources are actually perceived.

On these considerations it is in development a work plan for the collaboration with choreographers in this particular space, for which the aim is to significantly differentiate from the Ambisonics approach.

4.2 Encoding

For creating movements of sound, so called spatialisation tools within an authoring framework [20] are needed. Movement design tools, for drawing trajectories of sound in space should make available any type of geometrical operation, grouping/singling of sources and trajectories, the possibility of a single and multiple virtual source representation of the same sound, tools for dealing with speed, including correction or realism of doppler effects and the relation with amplitude, gain attenuation and air absorption filters, synthesis of early reflections and reverberation: all these processes should be easily accessible by a composer, when inventing sonic choreographies; all those sonic issues should also be addressed, for a consistent representation of sound movement. For example, the current availability of plugins for encoding provides a standard three coordinates system or azimuth and elevation, which satisfies mainly the generic positioning of sounds in space. Although it is possible to use them to design trajectory of movement, more sophisticated design tools are needed.

The project Holo Edit [21 and 20] seriously provided a model, based on a Digital Audio Workstation (DAW) structure, for unify under the same interface a set of geometrical and spatial transformations and a communication system through OSC [22] protocol. Others platforms and plugins are worth mentioning (Open Music, the ICST tools for Max/MSP, Jamoma, WigWare, Harpex-b and Ambisonic Studio), but still they don't represent a unified approach that satisfies movement design to its core. This research, through direct comparison with dance, is trying to highlight these problems as well to find solutions for them.

The SpatDIF project is proposing a SDIF format for storing spatial information [20] and OSC for streaming data, which is embedded within HoloEdit and few others softwares. This should overcome the limit imposed by system design to aesthetic invention as mentioned also here [20, 2.2] .

Those two projects are based on a team of artists and researchers: that is encouraging as for the production of surround sound the development of movement practises and technology should not go without the composers input and experience, and I'd add as well of choreographers and motion experts.

5 Conclusion

This research is posing technical and theoretical interrogatives for the analysis of a creative process involving music composition for surround sound environments. The artistic meaning of sound movement is investigated, for which the realistic possibilities are assessed for the different systems used. The hope is, through interviews and demonstrations and with an aesthetic and compositional approach, to contribute in reaching the core of the problems to the improvement of the operational framework, knowledge and artistic potential of sonic movement design.

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