

BECAUSE WE ARE ALL FALLING DOWN. PHYSICS, GESTURES AND RELATIVE REALITIES

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ABSTRACT

Relative Realities, a media installation by Volkmar Klien, realized in co-operation with Thomas Grill investigates how movement and its perception relates across different media, modes and spaces. The installation's sonic aspects are generated in real-time in accordance to the installation's physical movement. This generative music engine is conceptualized and based on physical movement rather than established 'musical' parameters. Using a virtual physics (e.g. gaming) engine, physical interaction between objects, a flow of energy is created, which is then wired dynamically to sonic parameters on high (structural) as well low (timbral) temporal levels. Physical modeling in this context is applied not to synthesize sound but objects' behavior, to create and control flows of energy. Even though the following article describes an artistic approach to the issues at stake we hope that it will allow for cross-pollination between analysis and practice in the sonic arts.¹

1. INTRODUCTION

Formalisation of music, in its various guises, has been a subject fascinating practitioners and theoreticians of music throughout the centuries. In installative contexts and in those where interaction with audience members or other non-linear dimensions of a work are required in the digital domain, formalisation becomes a practical necessity. Other than in traditional situations of composing, where things only need to be written down or recorded on storage medium, artists here are challenged to fully formalize intended sonic behavior.

Handing over decision making to a machine, artists need to confront the fact that not all logically coherent generation routines and rule systems are able to imbibe themselves with the authority to guide comprehensible musical evolution, to convincingly model sonic causality. In the section below we will shortly outline some of relevant issues.

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1.1. Formalizing Beauty

Creation of music cannot be done justice if viewed as an autonomous, formal endeavor. Setting out to design a generative music engine or a soundscape/texture engine one immediately realizes that not everything that works mathematically is bound to work on an aural level and that this is not only a question of complexity or lack thereof.

1.1.1. Symbolic manipulation

Given that the traditional musical score is a collection of symbolic descriptions, applying the symbol manipulation paradigm to music was a very appealing proposition, which underlies many of the existing approaches to generative music. *Leman* [9] rightly points out that pure symbol manipulation always depends upon what *Fodor* [4] refers to as methodological solipsism, leading to a situation where a programmer creates an imaginary world of symbols and meanings that is meaningful only to him- or herself or another programmer who understands the symbols and their meaning, hence providing no connections to actual sound.

1.1.2. Authority of rule systems

Wittgenstein proposed ([15], see also: [8]) that rules draw their authority from established use and not from being logically sound. Expressions and representations of rules imply a certain use only because we are used to interpret/use them in certain ways. It is its use that is essential for the meaning of a rule-expression, i.e. its binding character. Hence the use of a rule cannot simply persist in following explicitly predefined rules. Reliance on the fact that the meaning of a rule and its past use define a certain application of the rule is based on empirical, not logical grounds.

1.1.3. Description - Causation

In symbolic, linguistic description of music there seems to exist an inherent tendency for the symbolic language, the codes of describing music to take on the role of music's causes, the motivation of musical composition or music making in general. The language of describing is then inter-

preted as the language of music itself (cf. [14]) and analytical models of musical style substitute for artistic motivation.

Formalisation strategies for the generation of music are more often than not based on the manipulation and creation of units and parameters established as musical such as notes, pitch, rhythm and harmony. Underlying this approach there seems to be the notion that musical composition mainly concerns itself with the manipulation of musical parameters and building blocks bound by a fixed and established syntax. Viewed from a composer's perspective, this approach seems closer to modeling a model student of harmony and counterpoint doing homework rather than compositional activity, which – judging from personal experience – is a completely different creature. Automatic compositional systems abstracted from existing musical styles hence tend to result in rather weak and overly typical specimens of a compositional style of times bygone rather than exciting contributions to the audible arts. This is not because of technical imperfections to be overcome, but because of the underlying conceptualization of musical composition.

1.1.4. Isolating music from context

Viewing music as sequences and modulations of established musical parameters reduces the work of art to an object or network of internal relationships, robbing it of its context and social role. *Joseph Beuys*, in his reaction to the erection of the Berlin wall, suggested to raise it by 5cm for improved aesthetics. The point intended was that viewing the wall from a purely aesthetic point of view, perceiving only its proportions and their aesthetic value means defusing it. [1]

Even though this ironic statement did nothing to influence the wall's physical presence, it still raises a point virulent in any attempt to formalize music by firstly reducing it to relationships between amplitudes and frequencies.

1.1.5. Separating musical structure from sounding activity

As *Smalley* rightly points out [12] there is no clear cut delineation between musical structure and timbre. Structural levels of listening are dynamic and what is to be considered timbral and what structural is a matter of context as well as individual listening habits.

Many generative music systems, by making use of pre-fabricated sound modules or software synthesis off the shelf import gestural material from musical low level models. While this is not a bad thing in itself, it still bears witness to a certain disconnect between what is conceptualized as musical structure and the actual sound perceived.

1.2. Cross-modal integration and metaphorical modeling

Ecological approaches to music and sound perception (building on *Gibson's* ecological approach to vision [5]) see per-

ception of sound and music as being strongly integrated with senses other than the one traditionally defined as 'aural' ([3], [9], [6], [10]). Its connection to action - in terms of action behind the sounds heard as well as relevance of and to ones own actions - presents another focal point.

As *Godøy* states [6]: "There is now growing evidence in the cognitive sciences [...] indicating that [...] sensory integration is not a secondary "by-product" of a "pure" sound stimulus, as has been the dominant Western view of perception and cognition in the past couple of centuries."

Music and sound perception on their own always contain elements traditionally seen as lying outside the aural domain and are firmly connected to perception of movement, the perception of underlying action.

The generative system presented here draws on the cross-modality of human auditory perception by modeling physical objects' behavior and interaction thus creating trajectories, temporal evolution and structuring. As a sub-symbolic approach grounded on empirical use it manages to avoid several of the pitfalls mentioned above. Even though the approach of generating sonic structures and modeling sonic causality at hand was developed in the context of a cross media installation linking physical movement with mediated visible and audible movement in various ways, it was also used in a production for dance theater² as well as electroacoustic composition³.

To be able to further delve into the conceptual details I shall firstly present a short overview over the workings of *Relative Realities*.⁴

2. RELATIVE REALITIES

A pendulum swings through a space. A video screen, constituting its pendulum bob, carves its path through the exhibition space. It presents - from its ever changing position - a view upon another scenery (see fig.1). Although freely swaying through space it collides with objects; invisible, but audible. A computer traces the pendulum's position and - in a computer model - embeds it into a mathematical model of the exhibition space where it collides and interacts with objects (see fig.2).

Around the physical pendulum, along the exhibition space's walls, a multi speaker surround sound system is installed. The pendulum is set into motion in a controlled manner. Synchronized to it with the help of sensory devices a computation model of this pendulum swings through a virtual world full of objects - again and again, it collides and interacts. Made of numbers, this pendulum is not slowed by

²*Standing in Ink* by *Daghdha Dance Company* (Ireland), <http://daghdha.ie/002/002.htm#standing>

³*Gatsch* by *Volkmar Klien*

⁴*Relative Realities* was presented in its first incarnation at the *Wien Modern Festival* in November 2007, its third and latest at *Habitación del Ruido* (Mexico City) in September 2009.



Figure 1. The video monitor 'drawing' the scenery 'behind'

that, enabling it to stay synchronized to the real-world. Tangencies, collisions and mathematical interactions within the world of the computer generate and control the installation's soundscape.

Relative Realities models physical objects behavior as a reference set for the creation of sonic parameters. This virtual world remains invisible to the audience, linked to the one experienced visually only by the pendulum's dampened harmonic motion. Something is set in motion. Slowly it returns to a standstill. Next time everything will undulate in a rather similar fashion. Only the things in the computer change, and with them the sounds.⁵

3. PHYSICS AND SYNTHESIS OF SONIC BEHAVIOR

3.1. Everyday understanding of physics, musical gesture and aural perception

The generative sound system at hand does not reference physics simply for it to provide a closed system for the generation of control data. It does so because our understanding of as well as our ability to predict behavior of things in our environment is fundamentally shaped by it. Small children are able to catch a ball thus proving their ability to calculate trajectories, to predict physical movement; a competence at the root of all ability to set action. All perception (including the perception of music) unfolds in front of this backdrop. Things do tend to fall down, even the listeners themselves.

To be able to create comprehensible sonic behavior, to model perceived sonic causality, automated generation of soundscapes and music needs to evolve on common ground shared by artist, recipient and algorithm. A gaming engine⁶ models behavior deeply rooted and intimately familiar with all human listeners. Behavior of physical objects guided by

⁵A short video documentation is available online at: http://www.volkmarkliien.com/installations/rel_rea.html

⁶For the system at hand we made use of the open source physics engine *Open Dynamics Engine*, ODE. <http://ode.org/>

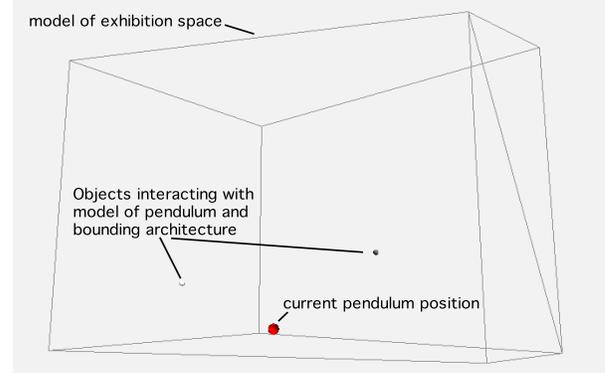


Figure 2. Mathematical Model

gravity, friction, etc. is not only familiar to everybody on a general level. We strongly believe that temporal structures and sequences derived from physical interaction are comprehensible, are perceived as one causing the other, even if decoupled from visual or haptic dimensions.

Numerous aspects of physical movement resonate in the aural domain. Several expressions of describing movement are commonly used for describing music and sound. These are not to be seen as literary metaphors only, but as rooted in the cross modal integration of the aural sense. Our physical environment shapes the expectations we have about sounds, their interrelations and their continuation in time and space. We believe that this plays an important part in our implicit concepts of 'natural', 'causal' development of sonic trajectories on various temporal levels.

3.2. Structuring evolution in space and time along trajectories of physical interaction

Physical modeling in the context presented here is not applied to directly synthesize sounds⁷, but to model the flow of energy between physical objects to provide the basis for the temporal evolution of sonic behavior on various levels. In doing so the approach at hand bears certain similarities to concepts developed in research into new forms of musical interaction, such as *scanned synthesis* [13] or *pmpd* [7].

Movement observed in the virtual world is dynamically rewired into sonic parameter space according to artistic choice. Trajectories of virtual movement are wired dynamically to different parameters of the generative engine. In its simplest configuration collisions of objects might trigger sample based sound events with object positions influencing their panning. On a temporally lower level the varying speed of objects can dynamically be attributed to filter settings or the density of granular structures. The same trajectories can be transposed into pitch information or onset decisions, quantized according to pitch and time lattices or not. Global

⁷For a short overview over several compositional approaches using physical modeling sound synthesis see Chafe[2].

control parameters in the virtual physics engine like gravity, object mass or density of air allow for efficient control over general activity by influencing the conditions for movement to occur thus influencing sounding behavior.

The goal of all this is obviously not to provide Foley to the virtual world to aurally illustrate its workings to the audience but to create electronic sound along control trajectories in concordance with action relevant affordances (cf. [5], [11]). Thus a metaphor machine based on the cross-modal integration of the senses is established differing fundamentally from approaches simply transposing data structures and models from one domain to another (e.g. mathematics to musical structure generation).

3.3. Spaces, virtual and real, and site specificity

The gaming/generative music engine roughly replicates the architecture of the exhibition space giving the virtual space (bounding the modeled physical action) and the exhibition space (bounding the installation's sound) corresponding dimensions. Recipients entering the installation are thus immersed in a life sized, surrounding sonic environment projected by a multichannel loudspeaker system using ambisonics. By adapting the virtual model to the space, the generative engine is easily adapted to different architectural settings, custom tailored for truly location specific sonic experiences. The physics of the exhibition space itself is beyond human control, over the virtual one we yield full control, allowing for peculiar relationships between the interlinking layers.

3.4. Modeling and Compositional Intention

At the beginning of the process of conceptualizing the generative engine at hand there stood a detailed analysis of the sonic behavior envisioned. This analysis led to the decision to model a flow of energy and physical movement rather than synthesize musical structure building on abstractions of musical style. Modeling compositional intention via cross-modal reference afforded a more direct route than the 'transposition' of intended behavior into traditional musical parameters and the consequent use of established generative routines would have allowed for.

4. CONCLUSION

Although the creation of *Relative Realities* was not originally motivated by recent approaches to music perception in the tradition of Gibson's ecological psychology, publications by Leman, Godøy, Clarke and others have motivated this article in the hope of instigating further dialogue between analysis and creation of music, that in electroacoustic music needs to be rather different from the one seen in traditional Western score based forms of music.

As analytical approaches to sound and music increasingly take into account cross modal integration of the aural domain and synthesis of sonic structure draws on other modes of perception, finding ways of more closely connecting analysis and creation of electronic sound from a perceptual perspective will contribute greatly to laying ground to new, non linear forms of sonic art.

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