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The Imaginary Friend:

Crossing Over Computer Game Scoring Techniques and Musical Expression

Maria Kallionpää
Aalborg University
Department of Communication and Psychology, Musikkens Plads 1, 9000 Aalborg, Denmark
maria_kallionpaa@hotmail.com

Hans-Peter Gasselseder
Aalborg University
Department of Communication and Psychology, Musikkens Plads 1, 9000 Aalborg, Denmark
hpg@hum.aau.dk

The purpose of this paper is to provide theoretical knowledge on how the interactive music techniques usually associated with computer game music could benefit the classical music composers and performers (and vice versa). We will focuse on techniques used in procedural music. Certain interactive computer game scores and sound installations represent this genre, as well as electronic real-time-based compositions that may or may not require a human performer. In the context of interactive computer games, dynamic music systems directly react to the gamers´ actions. The authors´ aim was to find out how such systems could be used as part the electroacoustic composer´s technical and expressive vocabulary. Automatisation challenges the concept of form, rhythm, and harmony in a musical work. Instead of a closed entity, a dynamic music composition is a never-ending story with infinite number of alternatives, which is why such works get created again in every performance.

Electroacoustic music. Composition. Performance. Musical games. Interactive music techniques.

1. INTRODUCTION

Musicians have become used to regarding musical compositions as closed and unchangeable entities. This significantly limits the versatility of composition techniques and decreases the originality of performers´ interpretations, thus leading to a stagnation of classical music culture. Applying interactive music systems would help to widen the classical music composers´ technical and expressive perspective, as well as to enhance the performing experience of the musicians. The significance of such systems have been widely recognised in the context of modern computer games.

Similar to a computer game, a procedural music composition can take a plethora of unpredictable turns depending on the player´s decisions. In this connection, the paper explores the possibilities of importing and merging game music scoring techniques to the electro-acoustic composition and performance. Moreover, it focuses on applying different features of music interaction scenarios (such as playing in orchestras or chamber music groups) to modes of communication between a human performer and virtual agents. On the other side, similar principles can be applied as to see what can be learned from traditional music performance situations for immersive real-time applications such as video games.
Ultimately, the goal of this paper is to provide a music theoretically and psychologically informed perspective on common issues in human-computer interaction ranging from synchronicity/velocity, navigation/articulation and appraisal/expression, which are being negotiated most effectively within the lengthy tradition that underlies a concert performance.

The significance and possibilities of interactive music systems have been recognised in the context of modern computer games. The concept of procedural music challenges the idea of a composition as a fixed entity. Computer game music often needs to adapt itself seamlessly to the player´s actions in a game environment: such systems are usually referred as *procedural audio* (Farnell 2007) or *non-linear music* (Buttram 2003).

Similar to a computer game, a classical music score based on such techniques can take a plethora of unpredictable turns depending on the player´s decisions. The purpose of this article is to provide information and ideas for the use of music professionals and game designers by exploring the possibilities of importing and merging game music scoring techniques to the classical electro-acoustic

composition and performance. Various game composers and researchers have successfully imported classical composition techniques into the game music context, but there has been little research on how to apply interactive game scoring systems into classical music composition. Our research project aims at optimising the performer interaction by creating an audio game environment that uses music as its core material but may also use other sounds as signifiers.

The intention is to develop a procedural audio engine that would be used to actualise and replicate virtual spaces (as discussed by Grimshaw (2015) the terms "virtual world" and "virtual environment" usually refer to computer-generated environments) and herein interacting agents to the performing situation. These agents can be expressed as video game avatars, whose relationships to each other and their virtual environment can be bidirectionally mapped to one or more musicians (Gasselseder 2012). By these means musicians will be provided with altered conditions within a performing situation that entail dynamically evolving narrative, challenged-based and aesthetic goals. This is believed to support a successful negotiation and realisation of individually meaningful motives for seasoned musicians but also for those who see themselves confronted with new challenges/repertoire, group formations or otherwise ambivalent performing situations.

Through an interactive design process that takes into account the perspective of composer and performer, this approach promises new insights on musical communication in classical music culture.

2. THE GAMIFICATION IN CLASSICAL MUSIC

The classical music performance tradition generally treats a musical composition as an unchangeable object. Furthermore, the global recording industry has set the standards of performing the historical masterpieces, which the performing musicians and instrumental teachers worldwide are trying to replicate. In this context it is often forgotten that the concept of form in a musical composition is, and has never been, that rigid: performers and composers have always been keen to challenge it.

Already medieval music allowed the performers to improvise parts of the music. A good example of this is Hucbald of St Amande who instructed how to improvise an additional voice to a given Gregorian chant (Essl 2006). The isorhythmic motet of the 13th, 14th, and 15th centuries, also enabled the realisation of musical material in basis of compressed notational information (Kallionpää 2014). Later on, it was usual that the virtuoso soloists of the Baroque and Classical era improvised their concerto cadenzas or parts of their opera arias and the keyboard players had lots of freedom to decide how to interpret their figured bass accompaniment. Furthermore, musical dice games were especially popular among the composers of the late 18th and early 19th century. These include, for example, Mozart´s "Musikalisches Würfelspiel" and C.P.E Bach´s "Einfall einen doppelten Contrapunct in der Octave von sechs Tacten zu machen ohne die Regeln davon zu wissen".

When considering the composers of the 21st Century, John Cage was one of the first ones to include aspects of ludology and gaming into his music (for example, in "Song Book" and chess piece "Reunion") (Mendez 2013). As discussed by Edwards (2011), musical dice games can be seen to have paved the way for the algorithmic composition techniques also used in contemporary electronic/electroacoustic music. The composers using such techniques often regard their works mainly as processes rather than pre-destined entities: Chadabe (1996) underlines that one of the most significant steps in the development of contemporary music was the shift of emphasis from compositions being seen as "fixed objects" to composition as a living "process".

2.1 The State of the Art

Procedural content generation (PCG) refers to dynamic, algorithmic generation of game content. It enables music composition that "adapts more granularly to player experience, avoiding needless repetition and providing an evolving, more emotionally intelligent soundtrack" (Plans & Morelli 2015). According to previous empirical research, games that device dynamic music immerse players by increasing the game characters´ plausibility as well as alter the way how players position the game characters in relation to other characters, the avatar, and themselves within a semantic ecology (Gasselseder 2012).

Davies has applied interactive game music techniques in his compositions that represent audio games without tactile or visual content. *Deus Est Machina* and *Starfields* contain a synthetic voice that "generates music for you, in the generative triptych of percussive music; creates a narrative and accompanies it with music, in *Deus Est Machina*; and ultimately decides your fate" (Davies 2014). In their review of audio only games Röber and Masuch (2005) discuss different possibilities of immersing the player by the use of music and sound, as manifested in games such as AudioFrogger or Beowulf, and as also discussed with regard to composition and arrangement techniques by Berndt and colleagues (Berndt *et al.*

2006). On the end of classical music tradition, some composers have started to program their own software, too. For example, the purpose of Machover´s Hyper Score Software was "to invent new instruments and new modes of playing them" (Machover 2010). Although mainly targeted for professional musicians, it can be used as an educational tool. Karlheinz Essl´s "Lexicon Sonate" (1992) and "Sequitur" (2009) are also real-time systems designed by the composer.

Algorithmic techniques are associated with live recording- and sound processing. Essl calls them an "inspirational machine" by which to expand our musical experience (Essl 2006). Moreover, Alessandrini´s physical modelling and artificial reality instruments have opened up new perspectives in music composition and performance. The growing number of highly sophisticated interfaces provides significant results.

For example, the Hands of Waisvisz has manifested great virtuoso potential, and Tarabella´s Imaginary Piano, Burtner´s MetaSax, Scavone´s Pipe, and the Hyper Flute of Palacio-Quintin offer extended sonic possibilities (Young, Nunn & Vassiliev 2006). In order to imitate and change acoustic properties, progress has also been made at the end of acoustic modelling, such as Lokki´s entirely digitally modelled orchestra for Pulkkis´ concerto for piano and Genelec orchestra (Pulkkis 2013).

The concert performances of game music scores usually lack the interactive content. Performing computer music scores as part of a regular classical music concert strips them from their responsiveness and interactivity, which is the key component of their originality. In procedural music, "the narrative and dramatic arcs are based on real-time choices made by the player" (Sweet 2014). The pre-structured randomness differentiates this kind of a situation from improvisation or algorithm-based independent music systems.

3. THE PERFORMATIVE AUGMENTATION

Whenever performers intend to bring a music composition to life, they encounter the problem of properly articulating what is believed to be the fundamental artistic idea, and more arguably, the representative character of a state of mind or situative quality that is ascribed to its realization. Besides actually applying the operating instructions of a score to an instrument, the present acoustic scene and ergonomics as well as the individual mental state, such as attention focus or mood, all need to be taken into account when adapting to the situative affordances of a particular piece of music.

But what if a performer lacked intuition and expertise to adapt to these contextual variables? Or in other words, what if we lacked the ability to change how to handle an instrument in context or under varying acoustic conditions?

While the above scenario may outline an extreme, the challenge as well as the potential enhancements experienced through augmenting one´s own surroundings by technological means promises to optimize expressive performances. In an on-going pilot test that devises a binaural microphone/earphone combo setup, we examined the question to what extent changes of acoustic parameters alter a professional performers´ interpretation of contemporary piano works in a real-life rehearsal/examination setting.

Data gathered from audio- and MIDI recordings as well as focus interviews that were conducted with seven professional pianists examined how alterations of spectral-dynamics (EQ, Dynamic EQ, distortion, compression) and room acoustics (reverb) would affect the learning of new repertoire under varying situational demands (practising, examination). Subjects were presented with two conditions where the first showcased each effect parameter in random order at 50% and 100% dry/wet ratio applied onto the signal path, whereas the second condition allowed subjects to select and control effect parameters at free will.

While a more detailed analysis will follow as soon as sample sizes allow for statistical control, first results indicate support for our initial hypotheses of altered acoustic conditions supporting learning of new repertoire and expressive control. Consistent with the more pronounced rhythmic articulation observed in the MIDI performance recordings, subjects reported of benefiting from reverb settings imitating a concert hall as well as increased levels of distortion during the later stages of practising and examination.

At earlier stages (practising), however, a more intimate setting was preferred that was accompanied by less pronounced velocities, which in our data appeared in the form of dialling in higher compression of dynamic range, a low pass EQ with a lower cut-off frequency between 6 to 7 kHz at 36 dB/Octave, and low levels of distortion.

The differences of chosen audio parameters between the stages of practising and examination seem less surprising considering the typical acoustic characteristics that performers have been acquainted to, as with situations in which music material is studied for the first time versus situations, which involve the polishing of an otherwise flawless technical realization. Thus, novices may benefit even more from applications

that aim to enhance audio to a performers´ preferences. The latter may have wider implications for inductive learning within a situational trait paradigm.

Other work speaking for such potential effects of transfer learning may be found in Gasselseder (Gasselseder 2012; Gasselseder 2015). Besides several correlations between personality traits and immersive experiences in a video game setting, these studies observed increased avatar control and perceived/performed possible actions depending on whether audio parameters had been adjusted to a user´s personal preference or not. Following this, altered acoustic sceneries show potential to optimise input modes of interfaces in music performance (instruments) as much as in human-computer interaction.

A more coherent approach to user-aware audio interface design would not only implicate the altering of environmental/acoustic or contextual variables in the interest of the current task, but increasingly amount to an adoption of common user interface features on the user end. At this, modes of communication devised during instrument practising could gain relevance for tasks that were originally associated with other domains. Thus, a performative augmentation, due to its adjustment of perceptual reality and strategies of assimilating situational affordances, may result in the augmented performer who implicitly adopts a task-related semiotic vocabulary for other interfaces.

In order to exemplify this, we draw on an analogy between modes of feedback of a grand piano and a text keyboard. Whereas the keyboard of a piano provides audio-visual and tactile feedback depending on the velocity and dynamic, with which a key is hit, a proper equivalent seems to be missing in the world of computing. Word processors could benefit from the sense of adding weight to individual keys by means of acoustic feedback. In this vein, writing in standard versus bold letters could be accentuated by different audio samples that indicate their relevant input modes.

Looking at these examples, it is to be expected that performative tasks within different domains grow closer and afford new aesthetics, which will not only be defined by simple execution of pre-existing instructions but necessitate a newly acquired skill of adapting to changing perceptual realities. Such a perspective could inform a performative augmentation that transcends the realm of music expression and player interaction by means of ludological abstraction, as will be showcased in the following section.

4 IMPLICATIONS: REALISATION OF A MUSICAL COMPOSITION IN THE FORM OF A GAME

4.1 The Purpose of the Project

Collins argues that “games are so new to academic study that we are not yet able to develop truly useful theories without basic, substantial empirical research into their practice, production and consumption” (Collins 2008). One of the purposes of our empirical research project is to contribute to the development of such theories by using a combination of methods applied in computer game- and arts research. Borgdorff (2009) divides arts research into three categories: research *on the arts*, *for the arts*, and *in the arts*. The approaches of Collins and Borgdorff form a foundation of our research, the main objective of which is to gain information for the use of computer game researchers and industry, as well as creative artists by a) developing an interactive music engine and b) reflecting on the research object from the perspectives of a performer, composer, and game designer/researcher.

The purpose of the procedural music engine is to allow the player/performer simultaneously to play a game and to create artistically meaningful content that can be performed on stage, thus also making this kind of a performance interesting for the listeners. Implementing virtual instruments and real-time manipulation of the instrumental sound according to the player´s actions allows complex instrumental techniques that would not be possible in a regular performance situation. It also enables the multiplication of the existing instrumental skills of the performer and actualisation and replication of virtual spaces in a concert hall setting.

Furthermore, the engine provides access to more versatile sonic environments with real-time tempo, rhythm, and harmonic variation. An important input mode of our procedural music engine is to enhance the skills of the player as a classical musician (in terms of expression, technique, and musical communication with human or computer performers) and as a gamer. Although every performance/game with the engine is different, the player gets better every time they use it.

4.2 Technical Realisation

The main technical requirement for using the music engine is a MIDI-controlled acoustic grand piano, such as Yamaha Disklavier Piano or Bösendorfer CEUS. These instruments are capable of providing direct feedback on the keyboard and allow the player to perform actions that would be otherwise technically impossible. For example, recording the instrumental performance of the player/gamer and

playing it back when required by the narrative, playing multiple octave ranges simultaneously, reaching chords normally too wide for a human performer, adding velocity or complex polyrhythms, changing the tuning in the middle of the performance, to mention a few features. The audio engine is designed in Max/MSP (Cycling'74) and the game environment is built with the Unity engine (Unity Technologies).

The first stage of the development was to revisit and organise initial data on performer interaction in electro-acoustic scenarios, as was investigated by Kallionpää (2014). Furthermore, information was collected through focus interviews with a small group of selected professional musicians with varied experience in human-computer interaction situations in a concert performance. The group was asked to express their positive and negative experiences of this kind of performing situations, as well as their thoughts and suggestions with regards to the functions and responsiveness of an ideal electronic system. This information flew into the development of several patches in Max/MSP. The most suitable are integrated with the first version of the game environment, which will be used for testing and prototyping the system.

The prototype only involves one player but the intention is eventually to build up a multi-player setup. Every participant hears from their earphones their individual set of sound effects, acoustics, and music that reflects their location, mood, and actions (virtual interactive situations). The decisions of each musician will, in addition to their own sonic material, affect the structure of the soundscape that will be audible to the players/gamers themselves and the audience (actualisation of the virtual situations). Similar to first-person multiplayer games, players will react to each other´s cues and navigate in a virtual sonic environment in which their actions on their instruments dictate how the story continues. The changes of sonic parameters will be linked to the performers´ movements on their instruments (such as, for example, velocity of touching the keys and articulation), choice of pitch material, rhythmic decisions, tempi, and volume of playing. Sensory and sonic data will be collected, to which the system will adjust the sonic situations. The players will encounter different situations that will be aurally communicated to them.

4.3 The Narrative and Its Realisation

Climbing on top of a high mountain forms the storyline of the game prototype. In the journey the gamer(s) react on the obstacles and possibilities offered by the virtual environment. The participating musicians/gamers communicate with the help of their music instruments. For example, climbing requires a certain type of an articulation, playing techniques, and velocity that the player(s) will need to achieve in order to meet the goals of the game. If the player fails to touch the piano keys with a correct articulation, the piano mutes the keys and no sound comes out: the game (and journey) can only continue when the player discovers the correct mode of playing. If the player stumbles on an obstacle within the game environment, the piano plays back the real-time recorded performance of the gamer in a reverse order. If he/she falls down the system plays back the recording a random interval lower than the original. The performer has to start playing in a lower octave range and to move higher according to the rules of the game. A main culmination point of the narrative is a group of birds attacking the avatar. The gamer/performer needs to keep them away by “fighting against” the piano by defending a designated octave range in a fast music passage where the digital piano attempts to take over the keys.

In addition, at each given point the altered acoustic characteristics (i.e. applying reverberation and echo associated with the mountaintop) of instrumental feedback will indicate to the player their relation to the environment and potential other agents, as operationalised in a single- or multiplayer game. In this way, the realm of *situation awareness* (Endsley 2013, Gasselseder 2012) is intended to shift from the limitations of the actual physical performance to virtual transcendence. Further prototyping may include a romantic scenario, in which the players respond to each other´s “feelings” musically (longer/shorter sounds, lighter/stronger dynamics). If used as an educational tool, musicians will learn how to respond to the other players (either human or electronic), as well as to adjust their expressive capabilities by means of adjusting tempi, dynamics, and articulation to the acoustic conditions.

5 CONCLUSIONS

Computer games using music as their core material are an emerging and vital area in the modern computer game industry. Good examples of this are “Guitar Hero” (Harmonix Music Systems 2005) and “SingStar” [Sony 2004] that have achieved considerable audiences throughout the world. Moreover, audio only games are an increasing point of interest for game designers/researchers: modern audio games are not only meant to the visually impaired, but to everybody.

Combining the principles of an audio game and an interactive video game provides a potential that could be exploited in the context of classical music composition and performance, as well as music pedagogy. Learning how to play within a human-computer interaction environment would provide

the musicians innovative tools on how to interact within a chamber music interaction situation in changing conditions. Applying interactive music systems and new technologies used in computer-game music scores would help to widen the composers´ technical vocabulary. The roots of classical music composition and game design often overlap. Both fields are determined to find new modes of expression and form. Considering the general interest towards interactive computer games involving music making, this field is worth further research and investigation.

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