MUSICAL NONLINEARITY IN INTERACTIVE NARRATIVE ENVIRONMENTS

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ABSTRACT

Music in modern interactive media performs a multitude of expressive and narrative functions, especially as a non-diegetic manifestation which is particularly distinctive in the computer games scenario. Consequently, musical features are connected to non-musical elements of the virtual scene. Unfortunately, the structure and aesthetic necessities inherent in music are very often incompatible with the behaviour of their correspondents. For instance, situations change faster than the music can organically follow or they take more time than the music has been composed for. Not every musical element can be adapted in the same way. Under varying conditions they react with different latencies. This leads to the question of the potential of musical features and of appropriate analogies between musical and non-musical elements. The paper discusses which elements of music are able to play what kind of role, and gives guidance to composers and developers for an adequate metaphorisation.

1. INTRODUCTION: THE ROLE MUSIC PLAYS

When music is included in a multimedia setup, e.g., in audio-visual media, it is no longer an autonomous occurrence. It participates in the vital interplay of various medial layers. While the visual layer dominates most frequently, there are two possibilities to involve music in the virtual scene.

As an element of the scene's interior (e.g., a radio, a live band) it can be heard from within. This so called *diegetic* music is commonly situated on the (background) sound effects layer and acts as a prop or a means of the performer's emotional expression.

Non-diegetic music, i.e., the common musical soundtrack, by contrast, can be perceived by the audience only. The relation of music and scene can be characterised as parallelistic, affirmatively complemental, or contrapuntal [14]. According to Wingstedt's systematisation [22] music can fulfill emotive, informative, depictive, guiding, temporal, and rhetorical functions.

However, in interactive media the audience is an active participant in the diegetic development. Since they are already conditioned by the narrative conventions of (western) film culture, they understand and react to the musical statement [11]. Thereby, non-diegetic information can affect the diegesis indirectly.

This situation necessitates a deliberate conception of the role that music has to play. It no longer stands in interplay only with the visual layer, even though this still acts an important part. The interplay includes the interactive momentum, too. Music can take a stand on playing behaviour; it can follow the player (parallelism), feedback or even judge the player (for past actions), influence playing behaviour and decision processes.

The success of any narrative conception necessitates a musically coherent correlation to underpin its believability and congruity. From this claim the major conflict, rooted in the ontological variousness of the art forms, arises: musically consistent aesthetics do not easily map onto non-musical (aesthetic) structures.

2. ONTOLOGICAL ANTAGONISMS

Music as it is commonly applied in interactive media is a static linear entity. Each time it is played back the result will be identical to all previous iterations. This strict determinism contravenes the nature of interactive media which are non-deterministic by definition. Composers scoring interactive media are faced with two contradictory requirements.

On the one hand, music has to be **short-term reactive**. The user does not synchronise his interaction to music, at least not consciously. So it is very often cut hard and asynchronous to the inner-musical flow. For psychological reasons this unmusical *hard cut* is regarded as a very special means for extremely abrupt and very often surprising events or changes. It ruptures the overall coherency and introduces the new (musical and corresponding non-musical) element out of a continuous context [6]. Hence, it is unsuitable for accompanying common scene transitions or developments within the scene.

On the other hand, it is hardly possible to predict the **unchanged continuance** of a scene. A finite musical composition has to cover an uncertain period. The most commonly used means to handle this is the *infinite loop*. However, exact repetition usually contradicts the actuality of an ongoing scene. Music becomes an alienating element that rubs off the unintended aura of a time warp on the scene.

Music adaption techniques are required to tackle the challenge of an organic correlation. However, each adaption gears into the continuous precomposed flow and may potentially be at odds with it. Just-in-time adaptions risk attenuating inner-musical *congruity*.

3. CLUES FOR MUSICAL NONLINEARITY

It is not the aim of this text to elaborate one specific adaption technique, but rather to identify and discuss those musical features and feature spaces that abet such interference and to which extent. The following Sections will evolve consecutively from the arrangement of static musical elements toward a growing potential for non-determinism.

3.1. Sequentialism

The earliest approaches toward nonlinearity can be found in the musical dice games of Kirnberger [12] and Mozart [18]. Music can be understood as a chronology of self-contained non-overlapping segments of various lengths from one up to multiple bars. The segments can be permuted, left out, or replaced by alternatives, which is a powerful means especially for loop variation.

A variant of this idea is implemented by Land & McConnell in their famous music engine *iMuse* [13]: Within a musical piece there are jump marks which can be activated during playback to make a seamless turn to a different position within the same or another piece.

As far as the composer takes care of the metric, melodic, and harmonic connectivity of all possible continuations, the resulting musical output appears to be very consistent. However, short change latencies necessitate a fine granularity, i.e., short segments. Hence, the composer cannot go too far musically within a segment to get back to the connectional context at its end. Moreover, the compositional effort, especially when including alternative segments, is quite high. Thus, pure sequentialism features a limited diversity and flexibility.

3.2. Parallelism

Not only the sequential/horizontal order of a musical arrangement offers starting points for adaption but also its vertical order, i.e., the interplay of multiple simultaneous parts. Different orchestrations can achieve timbral changes and help to elaborate various compositional details [19]. In addition, in multiple counterpoint the vertical order of parts can be permuted. This technique is not restricted to a particular style. It can be found in Bach's *The Art of Fugue* (BWV 1080) as well as in dodecaphonic music [1].

Beyond this, each combination of different parts does not only have to perform the same contrapuntal arrangement, but rather introduces its own exclusive material. This idea of varying part combinations is rooted in the baroque *building set manner*, as demonstrated by Berndt [2].

The parallelistic timbre and content variation is a mighty tool for loop variance. Fading techniques can be for each part separately and can achieve short-term changes. These *part-exclusive fadings* are predestined for smooth gradual polyphonic complex changes over long as well as short transitional periods, hence, very reactive. In combination with sequentialism a wide range of arrangement possibilities opens up, as shown by Berndt et al. [4].

From the composer's point of view the parallelistic variance is restricted to the degree that neighbouring part combinations (those that can be combined or faded into each other in the interactive context) have to harmonise tonally and metrically with each other. This is in order to facilitate musically convincing cross-fades without unintended disharmony and rhythmic stumbling.

3.3. Performative Expression

Performative interpretations can bring out extremely different characters of expression. They can differ in timing, dynamics, articulation, time signature based accentuation, playing technique, tuning, acoustical and technical effects.

Friberg [9] describes how his performance rule system KTH can be applied to synthesise such adaptive performances. But even different performances of one and the same piece of music cannot simply be cut, since abrupt asynchronous tempo and dynamics changes would be in no way better than the *hard cut* (as discussed in Section 2).

To step into the breach, Berndt & Theisel [5] introduce a style-independent method to create organic musically convincing transitions of performative characteristics. It furthermore provides musically better transitions for parallelism-based features: pure fading, as it has been described in Section 3.2, especially from or to zero loudness, is often associated as a mere technical effect with minor musicality. Even a *decrescendo al niente* usually has a clear ending at a minimum loudness level which is specific to every instrument and to the player's aptitude.

Thus, performance synthesis techniques do not only enrich the musical expressiveness but also the quality of mere sequential and parallel adaptions. With regard to loop variance, it has to be stated that the musical material, although performed more or less differently, remains unchanged. To tap the full potential of variance, the performative aspects should be combined with sequential and parallelistic feature adaptions (e.g., building set principles).

Performance style transitions can be done quite quickly within a few seconds and even in sub-second intervals if the styles do not differ too much in tempo and dynamics.

3.4. Compositional Transitions

The preceding Sections discussed multiple ways to adapt the arrangement and performance of a given composition. Only the sequential arrangement allowed a change-over to a different piece whereas the composer had to take care regarding the connectivity of successive segments.

It is possible to adapt the running music automatically to induce a better connectivity. Several approaches have been developed, like melody interpolation [16], fragment mixture and markov-morphing [23], or the weighted recombination within a genetic composition approach [10].

However, gearing into the compositional substance does run the risk conflicting with the aesthetic principles of the underlying style and may cause unwanted alienation. Therefore, a *structure protective adaption policy* has been introduced in [3]. Basically, transitions should not interfere with the musical flow but adapt the running material as unobtrusive as necessary. Meta-structural features have to be kept while the overall consistency is more tolerant to variations in accompanying parts (e.g., melody accompaniment).

Hence, stylistic and tonal likeness, and melodic proximity facilitate musically consistent adaptions. The more the pieces differ from each other, the bigger the compositional effort is to connect them (see Dickinson's explanations on style modulation techniques [8]). Thus, the greater freedom that accrues from automatically generated transitions is only of a local nature (within the compositions). The overall conception remains restricted to a certain extent. Likewise the reactivity; smooth style modulations usually require a phrase or semi-phrase, i.e., musically medium-term.

3.5. (Re-)Harmonisation

Reharmonisation is a very powerful technique to apply subtle changes in musical loops and to change musical mood (consider the famous example of a major-scale melody that is "minorised"). By more or less unobtrusive adaptions of melodic part leadings it is possible to vary chord gender, harmonic complexity [15] and even the chord itself [24], while melodic features stay recognisable.

Nonetheless, harmonic distance (no tonal overlapping of chords) can be in danger of causing melody alienation. The same danger also exists on the level of chord progression, as Yoon & Lee [24] state. A violation of the chord progression tempo, metre, and tonality can cause harmonic imbalance and stumbling. The whole counterpoint is harmed if harmonic and melodic progression exclude each other.

Thus, reharmonisation has to be done very carefully with respect to aesthetic stylistic principles. Close chord relations with strong tonal likeness weave better into their particular context. Reharmonisation is potentially more applicable within harmonically less restrictive styles. Since a possibly existent melodic-thematic material stays present, reharmonisation is most suited to accompany inner-scene changes which do not lead to something essentially different. These changes require short-term reactions which the reharmonisation can cope with, when considering an average harmonic tempo of a semi-bar.

3.6. Generative Scoring

Musical data can be created just in time. This opens up the opportunity to steer the parameterisation of the generation process by interaction. Music can be partly precomposed and partly created [17] or it is completely generated [7, 21]. Both are able to react quasi immediately to interaction. Since a hard switch can lead to incoherencies, especially if all music is generated, transitional style modulation techniques are needed.

In case of partly created music, the musical flexibility is restricted to the potentials of the precomposed material. A maximum of flexibility can be achieved by direct interaction with musical events. These can be incorporated into the musical flow as aleatoric-like elements and do not just have to reflect the occurrence of an interaction but also its quality (fast/slow, strong/weak). This is very close to the design of interactive virtual instruments such as specified in [20].

However, triggering events directly exposes the musical feedback to the danger of degenerating to a mere sound effect. To avoid this, it is necessary to establish a preexistent aesthetically convincing total structure. The triggered events have to be generated in a way that they integrate into the musical runtime context of this structure.

Insofar as no (or no relevant) interaction occurs, music runs in a quasi loop. Since music is generated, it is no longer necessary to repeat it but to create ever new material, thus, solves the problem of loop variance.

4. CONCLUSION

When music becomes adaptive it grows in its role as an active and dynamic participant in the interactive multimedia interplay. It is no longer just a redundant background feature or a clumsy kind of feedback but an elegant constructive enrichment. This text has elaborated the broad variety of possible routes towards musical non-linearity to enable music to be such a valuable dynamic medium.

Up to now there is only a handful of adaption approaches that focus on just a few musical features. This elaboration may inspire future developments to tap a bigger potential.

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