SEMIOTIC STRUCTURE AND RECOMBINICITY

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Abstract

This paper focuses on software based automated composition systems operated by a single user to create music for closed system dramatic narratives where the dramatic parameters are known but the dramatic shape and outcomes are not predetermined. The concern is with a system that will address Kansei (emotion based) [11] *approaches to narrative structure, musical generation, and performance. The model proposed allows for music creation from controlling a 'flight simulator' interface that represents emotional states rather than dealing directly with the composition process, allowing non-composers to recompose or explore a work in different ways. The system could be incorporated into non-linear interactive digital media, allowing different musical paths through a structure be taken.*

1. Introduction

Automated composition systems fall into distinct areas: Algorithmic composition from various non-human sources, such as fractals [12]; categorizing and reconstituting existing musical material [6]; interactive music systems [17]; systems for generating and specifying sound material [19]; and autonomous music systems that include Kansei material [4,15], usually with some sort of robotic input [19].

The idea of a Kansei (emotion based) [11] system centered on one computer driven by one user has begun to be explored theoretically as a means of automated film music scoring [7], but there are limitations in the theoretical model through addressing musical language independently of the emotional structure of the dramatic narrative. Further, the system proposed is a means of automating scoring for *linear* films.

Recent work in automated film/multimedia scoring suggests a way forward by beginning from existing moving images, translating these to an emotional dynamic outcomes, and assigning these outcomes to automated musical equivalents [9]. Non-composers can use this system. The limitations of this work in the first incarnation is that it cannot deal with complex dynamic moods, and it is primarily for linear systems.

More recent work [10] extends this approach by allowing a score to be automatically generated by images without the film having first to be manually broken into segment and moods manually assigned, making it more suited to non-linear approaches.

The advantage of both systems is the automation of Kansei based music composition with a musical/thematic sense, making them more aligned to traditional methods of music composition for general communication.

The drawbacks are that neither begins from an overall sense of the *dramatic structure* of the film or media they are to be used for, or are concerned with musical thematic development over an integrated range of outcomes. Further, although the notational outcomes are automated, the performance outcomes neglect Kansei approaches to automated performance [22]. These are also largely CRISP systems that lack a flexibility of responses to similar situations when repeated.

Recent work on mapping emotional narrative structures [20, 21] gives established composers the tools to generate Kansei based works from simulating the emotional flux and tension between part of a system, but not the means to generate music automatically.

By adding Kansei based music generators to Kansei structural models [21], a composition could be altered by dealing directly with an emotion scheme, addressing the limitations of current closed system. The modeling process allows for music creation from controlling a 'flight simulator' interface that represents emotional states rather than dealing directly with the composition process, allowing non-composers to recompose or explore a work in different ways.

The Kansei link can be reinforced by adding Kansei generators to the performance outcomes [22].

2. Modeling Narrative Structure

A Kansei based music generation system first needs to address dynamic narrative as structural expression in *combination* with a musical grammar approach to generation [14]. The limitations of a purely grammar based approach to recombinicity in this context are evident in the next section.

Research into applying system dynamics modeling [2] to map musical dramatic narratives [21] allows experimental composers to address the structural/semiotic way many non musicians 'read' music, and presents a contrary view to the idea that musical language/grammatical patterns and semiotic meaning are interchangeable. The method using system dynamics modeling is briefly outlined below.

System dynamics methods focus on simulating narratives based on influence diagrams, stocks, flows, and feedback loops [2]. They allow modeling based on actual figures, or soft concepts based on numbers assigned to qualitative scales.

software to simulate the narrative structures of plays to show different plot outcomes.

Developing these models relies on a three step process: drawing the structure of the narrative or situation being examined; making assumptions about the nature of the relationships between parts of the structure; and running the model in compressed time to illustrate the interaction of various parts. A main significance of these tools, in addition to checking assumptions about the situation being studied, is that they can be used to run 'what if' scenarios.

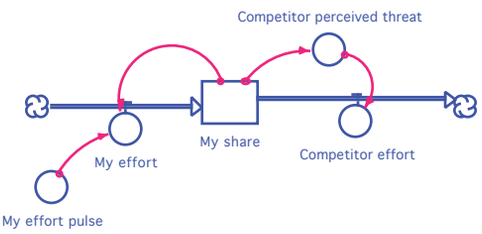

Figure 1: SD variation of 'Limits to Success' archetype.

The simple illustrative example model (figure 1) is built using *Stella* software; the double lines with an arrow represent the direction of flows of information (like verbs). A box is an amount or stock of something (like a noun). The single arrow lines illustrate feedback or influence connections. The 'clouds' indicate zero activity. The story told here is of increasing ones effort in the face of competition, and how one's effort is limited by the action of a competitor sensing one's increased efforts. Relationships between parts of the model are influenced by adding either graphs or formulas into parts of the object oriented diagram to reflect assumptions made. This takes place 'behind the scenes' in the software by entering a lower level, and are not seen at the runtime level.

Based on this notion, the narrative in figure 1 could, for example, be the story of the juxtaposition of two primary emotions in a play: an increase in happiness being offset by an increase in sadness, with the stock (middle box) reflecting the net result of emotion between two characters in a play. The strategy each character takes is added in the assumptions made when adding the formulas for the simulation.

Using system dynamics methods and software then allows for the modeling and simulating *closed systems narratives* and provides tools to help come to terms with the *dynamic structural* experience of emotional narratives [21]. The advantage of this approach as the basis for an automated music generation system is twofold. First, composers can use Kansei information as the basis for *structural dynamic expression*, and very complex emotional narratives modeled. Second, by using commercially available software, simple flight-simulator interfaces can be constructed to control a few or many parts of a very complex SD models, allowing others to test different strategies and dramatic outcomes possible in the model without having to understand how to construct the underlying model's structure.

How does a composer/performer use the simulations to compose music? Writing music to reflect changes of emotion in dramatic situation is a longstanding tradition in the last century in narrative film music, with its roots in the operatic tradition [8]. The approach is incorporated in recent automated film music systems [9]. The historical techniques of film music composition allow creativity within a broadly agreed framework of semiotic meaning [17] with an *intended* audience at a specific time and in a particular context.

An advantage of the SD approach as a basis to move to an automated composition system, in contrast to others [6] is that it does not attempt to express meaning based in a shared semiotic scheme by taking snippets of previous musical *language* and reassembling them in an emotion/semiotic haphazard manner, but begins from coherent semiotic narrative. i.e. you have something to say in the first instance, or a story to relate with structural/thematic coherence. A parallel is that rather than attempting to write a book by learning grammar and collecting words from books, one starts from themes and plot, and then moves to realizing the story modeled on how a writer might control syntax and grammar. The recreated words (performance) must, however, also reflect the semiotic scheme, an issue that will be deal with later.

Given the difference in approach, the question remains how to automate the human agency (composer) or 'expert system' in an emotion/ semiotic grounded system; and how to keep the system flexible enough so that it does not have to be rebuilt for small alterations an operator may want to make to a flight-simulator interface interfacing the underlying system dynamics model which drives the composition.

4. Rigid Systems

Many automated music composition systems like M Music allow non-professionals access to music composition tools without high levels of expertise in music. Yet, the musical results are usually poor because of a lack of methodology to control dramatic musical structure and emotional semiotics. Professional automated composition systems such as MAX allow extensive music generation, but these systems are also not primarily grounded in emotional/dramatic semiotics.

An intuitive way to approach the automation problem from a compositional perspective, and the way many conventionally approach the problem in current automated systems [12] is to construct a number of music rules that will feed existing composition packages such as MAX, and add Kansei translations to the rule base [4]: CRISP systems built for specific instances.

There are however major limitations with the approach theoretically and practically, as there are with many current composition systems that use an approach that is too prescriptive in algorithmic composition. For example, even with greater random functions added and greater choice of material, the output lacks variety to single solutions, and the flexibility to be generalized.

The general approach is extended and implemented in current automated conventional film/Kansei music approaches [9, 10] which are influenced by automatic music generation based on

systems allow a flexibility of music responses not from specific emotion/structural mapping (which may sometimes reinforce but sometimes require *contrast* with visual information), but by interpreting the visual information imputed through scenic *feature extraction*. i.e. The primary technique becomes 'mickey-mousing' at a micro level.

A further limitation with these automated systems [9,10] is in not being able to quickly change the rule base, and the style of one composer (expert) dominating the musical outcomes. That is, they also lack generality like many algorithmic composition packages that are too prescriptive. In addition, with these systems, there is a problem in dislocating performance value and MIDI triggering of the generated score. Performance value as a means of communication is not integrated with the emotional/semiotic message conveyed by the Kansei structure of the narrative.

In order to be affective in a holistic sense of semiotic coherence, a Kansei based automated composition system then needs to integrate structural narrative expression, thematic generation tied to semiotic structure, and expressive output related to semiotic message. At the same time, the system needs to be robust enough to deal with many different problems, and flexible enough to generate a number of outcomes.

By using a SD [1] approach to generate the basis of the score [22] the advantage is that the emotional content can be very precisely mapped and with a sense of the overall dynamic; one is not tied to visual information as an input; the system is flexible to be used as a stand alone devise or in the context of many media, with or without significant visual input; and semiotic structure is itself becomes a significant means of Kansei expression. The disadvantage is that the parameters and structure of the closed narrative have to be mapped before the work can be *recomposed*. This becomes a *primary* creative/compositional act for narrative artists.

5. A Structure/language/output Kansei Automated Composition System.

Figure 2 (below) provides the conceptual model of the integrated Kansei system. There are similar approaches to some aspects of the model currently developed in robotics/Kansei field with musical outcomes [19] but it has yet to be fully explored with a Kansei base, or integrated stand-alone systems.

The decision maker module (adaptive agent) 'trades off' the rule base from a number of influencing modules. The Timing and Episode module alters tempo and converts the length of time available into bars, a standard part of most film music-scoring programs such as *Cue*. A phrase generator is included. Further, the module decides if a theme should be current or absent in the music depending on its prominence in the underlying SD model. Not all themes are present at all times. They may appear and reappear/alter, for example, with reoccurring episodes.

The theme to motive rule base translates emotional themes into musical motivic material. In the Western music tradition, there is a long history of this translation process in operatic Greig).

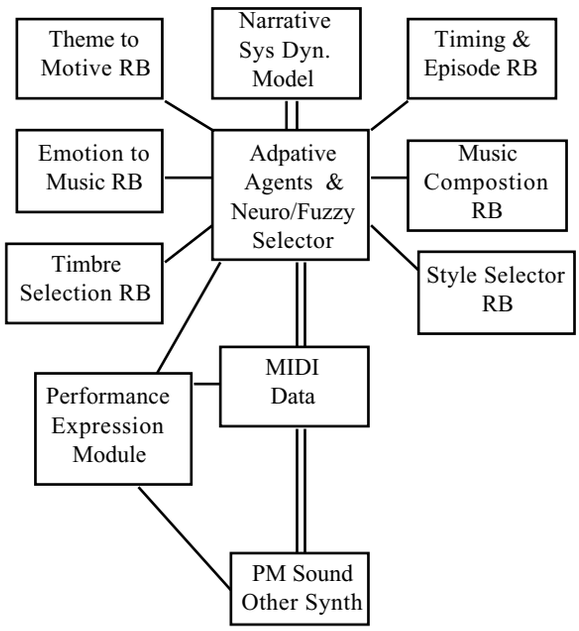

Figure 2. Integrated Kansei system

The dynamic manipulation of emotions based on musical themes is part of the standard techniques of film music composition (Korngold, Steiner), as is the manipulation of musical material to provide variation and interest in standard compositional practice. The rule base for this module based on these principles need not be extensive [6]. It is grounded in the way basic elements of music (pitch, rhythm, tempo, mode, timbre, pan, reverb etc.) react at the poles of emotional extremes [17], avoiding the need for an extensive expert system.

The timbre section module according to mood is a similar part of the standard technique of film music composition. For example, love as a Tuba rarely represents an emotion unless one wants to be comical.

Existing empirical and applied research work in the literature influences other aspects of the system.

Music composition rule bases modules on tonal (or atonal [6]) music grammar and syntax is part of many currently available algorithmic software packages [13] although few of these are driven by semiotic concerns. The rule base to match semiotic input to music output in generic terms based on conventional practice has been implemented in other systems [9].

Music style selectors are regular feature of many commercially driven sequencers, such as *Band-in-a Box*. The module includes composer stylistic signatures, a notion central to Cope's work [6] on aping other composers and extending one's own compositional work.

The output of the central decision making module triggers a MIDI data generator, influenced by the performance expression module, through applying, for example, machine learning methods to understand the relationship between emotional response and the manipulation of real-time instrumental performance elements [22] amongst other

dynamic model with performance expression to ensure that the performance reflects the emotional/semiotic basis of the music.

Physical modeling synthesis is intended as the main driver for the lead expressive parts, as this allows timbral control in real-time to be an aspect of expressive real-time performance in the way most acoustic instrumentalists manipulate this parameter as a means of expression. Background elements need not use the same synthesis methods.

6. Conclusion

The approach/ model presented attempts integrate Kansei information at a structural, generation, and performance level, and in doing so address criticism of other automated composition systems and even some aspects of current contemporary music composition. Through the generation of material from emotion GUI's by non-composers, it allows them to interact with sonic symbols, structural listening, and dynamic message in the semiotic language that reception experience is based. The same composition may then have many outcomes by altering the assumptions that generate the underlying SD model/emotional dynamic. This approach allows the evolution of non-linear narrative film music techniques in the digital realm, with or without visual information.

A criticism likely to be leveled is that applied to many algorithmic composition systems: GIGO, or the lack of originality. In answer, the ability of composers to reinvent within known archetypes is a difference between a focus on creativity in contrast to invention [14]. Also, the system proposed allows for 'experimental' styles to be continually added, modules to be continuously updated and extended, and random functions to be manipulated to create unexpected outcomes. Cope's [6] notion of 'recombining' as a legitimate form of creativity then remains central to the model, yet invention to be incorporated as original extensions stemming from a coherent semiotic structural dynamic.

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