Music Generation by Transformation
- Toward the Narratology of Music-

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Abstract
Music is not an only accompaniment for narratives. It is also a representation medium of narratives. The theme of this paper is proposing a methodology of automatic generation of music as representation medium. First, we describe a system which automatically generates melody lines from a backing based on the constraint of chord and musical knowledge. We regard this as a system based on the harmony as musical structure in micro level. Next, as an extension of this idea, we propose a methodology of music generator based on the transformation of music structure. We define the more macro structure in music based on the idea of Genette’s narrative discourse theory and its expansion by computational modeling (expanded literary theory), and show a framework of music generation by the transformation of music structure.

Introduction
We have studied computational expansion and precision of narratology. In this study, we think that surface representation media for a narrative do not limited to language. Generally, language and picture are used as narrative media. The position of music is delicate, and it is mainly used as the accompaniment of a narrative work. But, theoretical thinking, it is possible that music is also a representation medium itself for narratives. In this paper, we think music as a representation medium for narratives based on mainly narrative structural aspect.

First, we describe a system which automatically generates melody lines from a backing based on the constraint of chord and musical knowledge (Kobayashi & Ogata 2002). We regard this as a system based on the harmony as musical structure in micro level. Next, as an extension of this idea, we propose a methodology of music generator based on the transformation of music structure. We define the more macro structure in music based on the idea of Genette’s narrative discourse theory and its expansion by computational modeling, namely “expanded literary theory” (Ogata 2002), and show a framework of music generation by the transformation of music structure.

There are many studies about computer and music. For example, Aono (1998) explains about some jam session systems and their mechanisms. In these jam session systems, computer generates improvisation based on other instruments’ sounds. This methodology is similar to our first system in next section. However, the origin of our idea is narrative research or narratology and its computer modeling, but music or computational music research. Therefore, in the current phase in this study, we do not directly refer to computational music research.

An Automatic Melody Generator based on the Constraint of Chord and Music Knowledge
In (Kobayashi & Ogata 2002), we proposed an automatic melody generator based on the constraint of chord or harmony and music knowledge to consider on the relation between narrative generation and music generation. In this section, we explain the overview of this system as a framework of music generator in which the harmony is regarded as a part of musical structure.

Relating Musical Concepts
In this study, we divide musical elements into next three ones: melody, backing and words. Main musical instruments used usually in contemporary popular music are drum, bass-guitar, guitar and vocal, and they are often used in computer music or DTM (desktop-music) too. Backing, one of main musical element, is usually played by the instruments except vocal. It is equivalent to musical accompaniment and serves as the foundation of music. The most important element of backing is chord which means the harmony of each sound (table 1). As musical terms relating the chord, there are key, scale and root (figure 1). Key note is the first note of scale. Key is the style of note’s row. Scale means the row of note based on key. Root is the lowest note of the chord.

<table>
<thead>
<tr>
<th>Chord</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Root</td>
<td>C</td>
<td>D</td>
<td>E</td>
<td>...</td>
</tr>
</tbody>
</table>
Musical Theory and Experiential Musical Knowledge

We considered musical knowledge from two viewpoints of musical theory and experiential musical knowledge for formulating the method of melody generation. First musical theory corresponds to the knowledge in musical grammar. On the other hand, experiential music knowledge means the knowledge musicians use experientially in composition and playing of music. In this study, we regard consonance and dissonance as the most important concepts or a kind of core rhetoric for melody generation in the musical theory.

Consonance and Dissonance

Consonance means the notes for constructing chord. Generally, it is thought that the usage of consonance generates natural and beautiful sound. Normal songs are mainly composed of consonance. There is a root note as one of the consonance. Dissonance means the notes which do not construct chord, and is used for melodious decoration. Figure 2 shows a consonance and a dissonance corresponding to the chord C (c, e, g).

Outline of the Automatic Melody Generator

The developing environment of the melody generator is Max/MSP developed by Cycling '74. Figure 3 shows a screen of Max/MSP.

Max/MSP is a graphical program language. It is very useful for us to treat music. Figure 4 shows a screen of our melody generator. It generates a melody line in accordance with a chord advance of the backing inputted by a user, and outputs the generated melody line and the backing together as a sequence of sound. Backing information exists in MIDI files. Each MIDI file is fed into computer as one track. Three parts of the backing, namely guitar part, bass-guitar part and drum part, are prepared as three files for convenience. In first experiment, we preliminary prepared the backing data of a rock music. Of course, we can also prepare other music data. When the system gives the MIDI files to Max/MSP, Max analyzes each chord with the sound and transforms the sound to note number. Besides, the system decides the pitch of melody based on the rate of consonance, and generates a melody.

We show the algorithm in detail (figure 5).

User Input and the Analysis of MIDI files

A user can selects a MIDI file by pushing the read button, and then
decides the rate of consonance by operating the dial. Max/MSP transforms each chord in the MIDI files into the note number. Simultaneously, a user gives to the system the number data showing the tone color of the melody line to be generated.

**Deciding Melody Note** This corresponds to the core processing of melody generation. This is the processing deciding or adjusting the pitch of melody based on the rate of consonance by the user input using the knowledge about mainly consonance and dissonance. The note decided in a point of the processing is represented by a note number, and the note number is sent to next output mechanism. This processing is repeated until the data of chord finish.

**Output** The note number sent from above mechanism is transformed to corresponding sound by Max/MSP. At the same time, Max/MSP decorates the sound’s color of the note number based on the information of tone color given. The system outputs the result, and repeats this processing as long as the melody generator generates note number.

This processing is performed on time. In other words, this processing is executed at the same time with the music progress.

![Diagram](image)

**Figure 5: The outline of melody computer**

**Music Structure Transformation Based on the Narrative Discourse Theory**

We regard the automatic melody generator explained in previous section as a system which generates melody lines based on the harmony as musical structure in micro level. In this section, as an extension of this idea, we propose a methodology of music generator based on the transformation of music structure using narrative discourse theory. In this paper, we define the more macro structure in music based on the idea of Genette’s narrative discourse theory, a representative theory in narratology, and its expansion by computational modeling, “expanded literary theory” (Ogata 2002), and show a framework of music generation by the transformation of music structure. There are various techniques for transforming musical structure. We use narrative discourse theory, summarized in next section, for the generation of variations of musical structure.

Genette’s discourse theory (1972) is composed of following three aspects; time or tense, mood and voice. We explain them based on Prince’s summary (1987). Time or tense means the set of temporal relations (speed, order, distance, etc.) between story (narrative contents) and discourse or narrated and narrating. Order is one of its subcategories and shows the order in which events occur and the order in which they are recounted. Duration means the relation between story time (narrative world’s time) and discourse time (described time). Last frequency is the category which means the set of relations between the number of times an event occurs and the number of times it is described. Mood, next major category, is the set of modalities, distance and point of view or focalization regulating narrative information. Distance, first subcategory of two major factors in mood, means whether a narrator shows (the aspect of mimesis) or tells (the aspect of diegesis) narrative information. Namely, showing is taken to institute less distance than telling. Perspective or point of view or focalization is the perceptual position in terms of which the narrated situations and events are rendered. It is divided into three types: zero focalization, internal focalization and external focalization. Voice, last major category, treats the temporal and spatial relations between a narrator’s narrative action and a narrated text.

We think that narrative discourse theory is, so to speak, a universal rhetorical system for transforming a given text structure into various forms, and is independent of expression media. Therefore, we think that music should be also a medium for the expression of narrative discourse like language and picture etc.

At first, we would like to simply explain on what is musical structure in this study. By Gieseler (1975), musical structure is a sequence of parameters notes, sounds, and noises are connecting each other. He said that the difficulty of contemporary music for audience is reconstructing musical structure is difficult, and playing an attention to it is significant.

**The Correspondence between Narrative Discourse Theory and Musical Structure**

In this paper, melody and chord (or backing) are main elements in musical structure, and minimum units constructing them are note and beat. Formal structural elements in music using these elements are divided into two types: vertical structure and linear structure. The former has the theory of harmony and counterpoint, and the latter has development and construction. There are also musical elements like tonality, speed, and rhythm except structural elements. We try to organically relate these musical elements to aspects in narrative discourse
theory. We explain concretely the correspondent relations between musical structure and narrative discourse theory. Table 2 shows the correspondence.

**Story, Discourse and Narrative Discourse Theory** An original music is corresponded to a story, and this music is varied or transformed to various structures or forms corresponding discourse. We use narrative techniques based on narrative discourse theory in order to process the music transformation.

**Narrator** In narratives, a narrator or narrators surely exists as subject(s) of narration. In this research, we think each musical instrument (and players playing instruments) mounted within the system can become a narrator. A musical instrument plays a melody line when it becomes narrator. Considering the role of a narrator, this is appropriate.

**Character** Each character corresponds to a musical instrument. Each character is distinguished on the kinds of instruments. From the viewpoint of computer system, the difference of instruments is expressed by colors of sound.

**Narratee (or receiver or audience)** A user corresponds to a narratee. Although in literary theory the narratee is the existence or concept inside the story’s world, we regard simply it as equal existence with a user outside in the current phase of this research.

Table 2: The correspondence between narrative and music

<table>
<thead>
<tr>
<th>Concept of narratology</th>
<th>Music</th>
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<tbody>
<tr>
<td>Story</td>
<td>Original Music</td>
</tr>
<tr>
<td>Discourse Variation</td>
<td>Method of Variation</td>
</tr>
<tr>
<td>Narrative Discourse Theory</td>
<td>Instrument (=Player)</td>
</tr>
<tr>
<td>Character</td>
<td>User</td>
</tr>
</tbody>
</table>

**The Transformation of Musical Structure**

In this section, we explain the correspondent relation between categories in narrative discourse theory and the transformation of musical structure (table 3), and discuss concrete techniques for two examples, time order and frequency.

Table 3: Correspondence of narrative discourse theory and method of variation

<table>
<thead>
<tr>
<th>Narrative discourse concepts</th>
<th>Method of variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Order</td>
<td>Changing the order of musical unit</td>
</tr>
<tr>
<td>Speed (duration)</td>
<td>Changing the speed of note and beat</td>
</tr>
<tr>
<td>Frequency</td>
<td>Composing and transforming a unit</td>
</tr>
</tbody>
</table>

**Time Order** For example, it inserts an already appeared or past musical unit into a current point (analepsis), or inserts an not appeared or future musical unit into a current point (prolepsis) in order to transform the order of a story, namely original music here, into the order of narration (figure 6).

**Frequency** This musical function binds similar units (figure 7) or repeats a unit in an original music. It may compound similar units and binds these units. Conversely, it may divide a compounded unit into some units.
Toward the Expansion of Automatic Music Generator

By transforming a music structure using the musical rhetoric which was mentioned in above description, it becomes possible to compose various forms of music with the structure different from the original music. The function of automatic music transformation is controlled by parameters given by a user. The outline of the automatic music transformation system is shown below (figure 8).

![Figure 8: Outline of the system](image)

This system’s input is also MIDI files. But, these files are different from ones in automatic melody composer explained in section 2. In this system, it is necessary to decide structural units in an original music, and make a file each unit. However, we make two kinds of files of backing and melody by each structural unit to able to do different processing to backing and melody. In figure 9, B1, B2 and B3 shows respectively structural units in an original music, and each unit has two portions.

![Figure 9: Imaginary figure of input files](image)

Discussion: On the Mutual Transformation between Narrative Structure and Music Structure

In this paper, we showed a methodology for defining the transformation of music by narratological approach. Probably, in general approach about the relationship between music and narrative, music is treated as the accompaniment of a narrative work, or it is used as a kind of tool which decorates or appeals, so to speak, the semantic image of a narrative work. However, main analysis goal of narratology is originally narrative structural or formal aspect, and in this point, we can treat narrative and music as mutually transformative media. Namely, we can think on the mutual transformation between narrative structure and music structure. Although main media for narrative expression are usually language and picture and music is used a kind of decoration, it is possible that music itself becomes an expression medium for a narrative. As an example of study in which the relation between literary works and music are discussed, there is a paper about “Les Faux-Monnayeurs” of Andre Gide (Ninomiya 1965). But, because many literary approaches including this are not formal, we can not still directly use them in our research.

Figure 10 shows this research’s perspective based on the cyclic process between narrative and music. First, we think a narrative work as the starting point. This cyclic system transforms the text into a music structure using rules about the corresponding relations between narrative structure and music one. Next, it transforms the original music into variations using music rules based narrative discourse theory. Moreover, it transforms this music structure into a narrative structure. This cycle shows that narrative and music transformation respectively becomes possible through the intervention of different medium.

![Figure 10: A cyclic model between music and narrative](image)

We show the overview of this cycle using Max/MSP. First, the system abstracts the discourse structure of a narrative work to represent it on Max/MSP. In this
abstraction, each event in the narrative is divided into function, character and added information about discourse structure (currently, order, frequency, duration, distance, perspective and alteration). Figure 11 is a display of Max/MSP, and a program list inside “untitled” shows a unit of information representing an event. Narrative and music are related based on this unit. This becomes one unit in music too, and the structure of original music is decided by each unit.

![Figure 11: Narrative discourse structure displaying on Max/MSP](image)

Currently, the function in each event corresponds to melody, and the character corresponds to backing (melody and backing corresponding event and character are preliminarily prepared). In Max/MSP, for more flexible transformation processing, we divide a set of event information into each parameter (multi track recording). Figure 12 shows the divided expression on Max/MSP of an event.

![Figure 12: Mechanism of multi track recording](image)

Conclusion

Music is a representation medium of narrative. This paper proposed a methodology of music generation based on the corresponding relation between narrative structure and music structure. First, we described a system which automatically generates melody lines from a backing using the constraint of chord and musical knowledge, and regarded this as a system based on the harmony as musical structure in micro level. Next, for this extension, we considered a methodology of music generator by music structure’s transformation using macro structure based on Genette’s narrative discourse theory and its expansion by computational modeling. Based on these descriptions, we discussed mutual transformation between music and narrative through the medium of structural or formal aspect.

References