MIREX 2013 SYMBOLIC MELODIC SIMILARITY:

Melodic Similarity based on Extension Implication-Realization Model

Sakurako Yazawa, Yuhei Hasegawa, Kohei Kanamori and Masatoshi Hamanaka
University of Tsukuba
sakurako@music.iit.tsukuba.ac.jp, yuhei@music.iit.tsukuba.ac.jp,
kohei@music.iit.tsukuba.ac.jp , hamanaka@iit.tsukuba.ac.jp

ABSTRACT

We propose the method that Implication-Realization Model (IRM) for adaptation to the similarity calculation method and will be that submitted to the MIREX 2013 Symbolic Melodic Similarity. Current symbolic melodic similarity calculation methods using the original IRM cannot differentiate the interval direction of a note sequence. Our extension eliminates the ambiguity of the definition of the pitch change definition when analyzing music based on the IRM. Experimental results show that our method outperformed the baseline performance, which uses the original IRM, when calculating melodic similarity.

1. INTRODUCTION

The goal of this research was to calculate melodic similarity based on music theory. Toward this goal, we have been developing an extension of the Implication-Realization Model (IRM) [1,2] that adapted for the similarity calculation method and an extension IRM parser. The IRM we used was the music theory proposed by Eugene Narmour, and which can be expressed into a symbol sequence by using rests, pitch, and rhythm that, constite the music.

Various music similarity calculation methods have been proposed, which can be classified into "not based on music theory" and "based on music theory". Current similarity calculation methods based on music theory uses a melodic structure called a symbol, which is defined in the original IRM [6]. However, they are less accurate in terms of similarity calculation for the definition in which the pitch direction is not very strong in the symbols because they use the original IRM.

Therefor, when the IRM expresses two melodies as same symbols development, so listeners feel the difference of pitch directions. For example, the same symbol is assigned if the tones that behave like pitch, called "down-up" or "up- down", appeared in the music, and we listening to the melody completely differently.

To solve this problem, we extended the definition of the interval direction new order by using eight original symbols with ten extension symbols with our extended IRM.

In the following sections, we explain the basic concept of our Extension IRM parser and calculation method in Sections 2 and 3, respectively. We explain the experimental results and conclusions in Sections 4 and 5, respectively.

2. EXTENSION IRM PARSER

We have been developing the Extension IRM parser, which enables a user to input music into a system through outputting 18 types of symbols that have been expanded. The input is midi format music and output is a symbol sequence abstraction of a melody on the basis of the IRM. Figure. 1 shows the processing flow of our Extension IRM parser.

Our Extension IRM parser follows two steps as melody abstraction,

1. *Melody separato*r
2. *Original* or *Extension Symbolizers.*

A user enters midi format music into the *Melody separator*, which outputs a *bracket.* A *bracket* is input data to the *Original* or *Extension Symbolizers*.

The abstraction of music using the IRM enables expression of the symbol sequence that uses information constituting the music pitch, rhythm, rests and so on. The *bracket* is an important structure to abstract music. A *bracket* consists of units that enclose the sound of three consecutive melodies in a break, in and rest part, and note value rapidly changes before and after.

The *Melody separator* applies a bracket in two steps. First, the *Melody separator* creates a large notes column group to detect the location where the bracket is interrupted. Then the *Melody separator* applies the bracket of three tones from the beginning to the end of the group.

In the *Original* and *Extension symbolizers*, three tones enclosed by *brackets* are adapted to the symbol. There are two important points to generate the symbol. The first point is the pitch of the current two to three consecutive notes. The second point is the interval direction.

The *Original symbolizer* in our *Extension IRM parser* applies symbols to each *bracke*t. For example, the symbol called "IR" applies feature from same interval direction, large interval and small interval.

The *Extension IRM symbolizer* analyzes a symbol with our proposing extension symbols a total of 18 types. We extend the original 8 symbols to 18 symbols, as shown Fig.2.

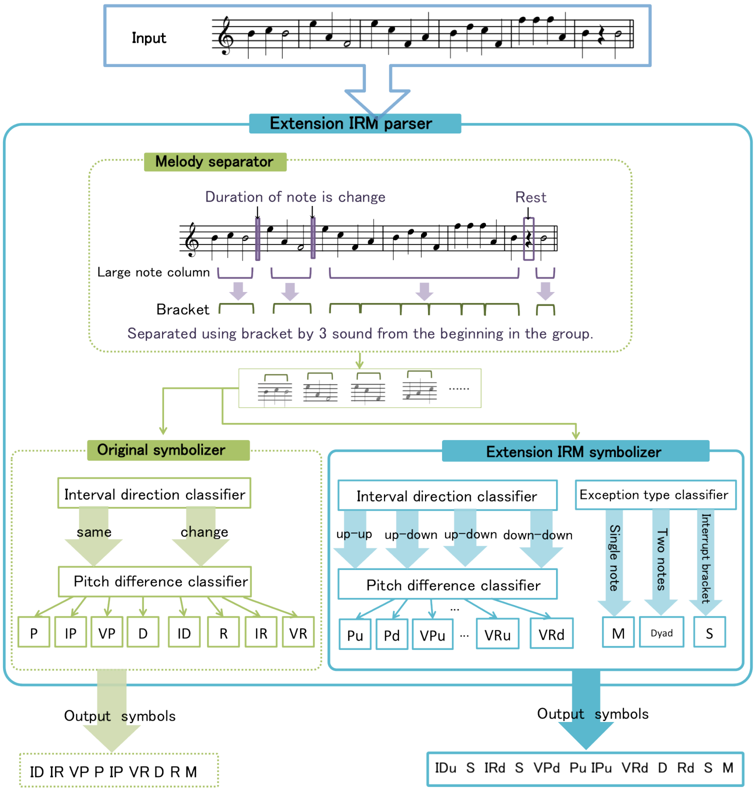

Fig 1.Processing flow of Extension IRM parser

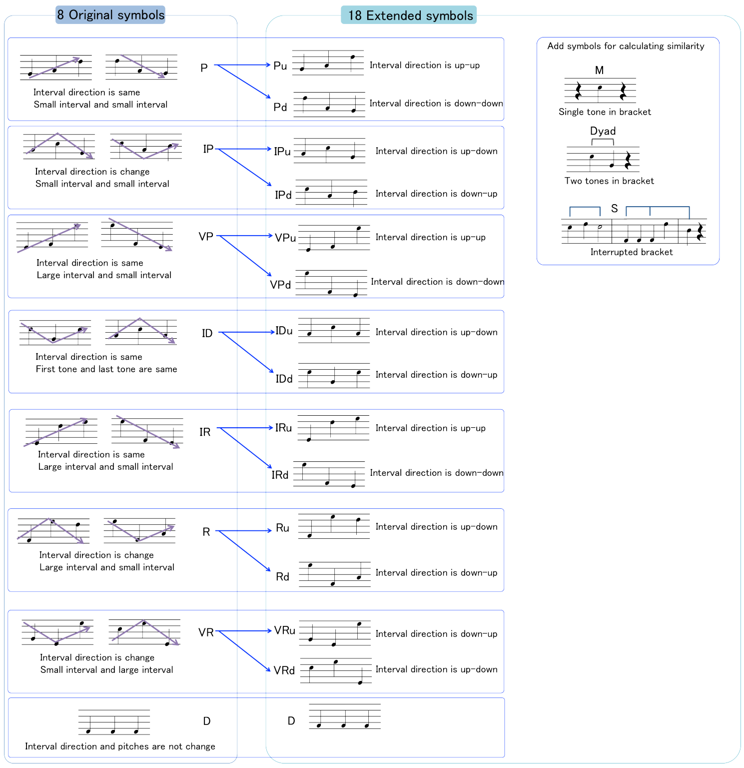

Fig 2.Original and extension symbols

3. CALCLATING SIMILARITY

Similarity calculation based on the IRM is conducted using pattern matching of symbols sequences. We use N-gram as the pattern matching method such sequences.

Figure. 3 shows the calculation similarity method that consists of three steps. First, to abstract comparison and query melodies from a symbol sequence, we input two melodies to our Extension IRM parser. Then we determine the degree of similarity using the N-gram of symbol sequences from the comparison and query melodies.

For calculating the degree of similarity, we use the expression in Fig.3

For calculating the degree of similarity, we use following expression (1).

$$S(query, comparison) = \frac{n}{\max(a,b)} \quad (1)$$

Where S: value of similarity(0≦S≦1), n: matching element count, a: element count of query melody, b: element count of comparison melody.

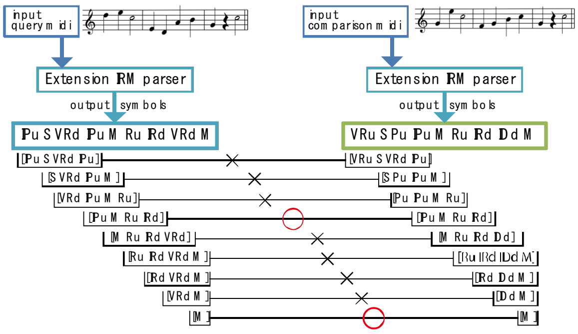

Fig 3.Calculation sample

4. EXPERIMENTAL RESULT

We now describe the results from evaluating the performance of calculation similarity methods and extensions to determine their usefulness.

We randomly selected one song from five thousands data sets of Essen as a query. We then added four new songs to the retrieval target data by manually editing the songs as follows; “one note deleted”, “one note inserted”, "one interval en-larged", "one interval compressed".

The four new songs we edited were included in the top ten songs of the output from searching similar songs.

When calculating similarity by using N-gram, we change the number of N from one to ten. As a result, using four as N was suitable for similarity calculation based on the IRM using N-gram.

We compared the basic IRM parser and our Extension IRM parser. From the top ten similarity results, the basic IRM parser output-ted only two songs for editing, which suggests that the current extension of IRM may be useful. We also investigated the subjective similarity by with five participants who listened to the top ten retrieval results of the query. A participant listed to all query and song pairs in random order without duplication. Every time he/she listened to it, he/she was asked "how similar was the query to the song?”, and ranked on a 5-brade scale; 1) quite similar, 2) similar, 3) neutral, 4) not similar, and 5) quite different. The top five songs edited four songs and the query. The other five songs were evaluated as relatively similar to the query.

From our preliminary experimental results, our proposed extended IRM determined to be useful for calculating melodic similarity.

5. CONCLUSIONS

We have developed an Extension IRM parser for similarity calculation based on the IRM with extended symbols. From our experimental results, our extended IRM was found to be useful for calculating melodic similarity.

To further increase the precision of similarity calculation, we plan to use another structure called "chain structure", which is represents the relationship of symbols defined in the IRM.

6. REFERENCES

[1] Eugene Narmour, “The Analysis and Cognition of Basic Melodic Structures” , the university of Chicago press, 1990.

[2] Eugene Narmour, “The Analysis and Cognition of Melodic Complexity” The university of Chicago Press, 1992.

[3] Julian Urbano, Juan Llor´ens, Jorge Morato and Sonia S´ anchez-Cuadrado, "MIREX 2012 Symbolic Melodic Similarity: Hybrid Sequence Alignment with Geometric Representations", MIREX 2012 Symbolic Melodic Similarity Results, 2012

[4] Fred Lerdahl, Ray Jackendoff: "A Generative Theory of Tonal Music", The MIT Press, 1983.

[5] Satoshi Tojo, Keiji Hirata, "Distance and Similarity of Time-span Trees”, Journal of Information Processing, Vol. 21 No. 2 pp. 256-263, 2013.

[6] Maarten Grachten, Josep Lluis Arcos and Ramon Lopez de Mantaras : "Melody Retrieval using the Implication/Realization Model", MIREX 2012 Symbolic Melodic Similarity Results, 2005

[7] Sakurako Yazawa, Hiroko Terasawa, Keiji Hirata,Satoshi Tojo, Masatoshi Hamanaka," Identifying the basic structures of Implication-Realization Model in a melody ",IPSJ special interest group on music and computer, 2010-MUS-87, No.1, Oct.2010(*in Japanese*).

[8] Sakurako Yazawa, Hiroko Terasawa, Keiji Hirata, Satoshi Tojo, Masatoshi Hamanaka," Analysis the chain structures of Implication-Realization Model in a melody ", IPSJ special interest group on music and computer, 2012-MUS94SLP90, No.34, Feb.2012 (*in Japanese*).