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Short Paper

Music Visualization in Style and Structure

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1. Introduction

Music visualization is widely popular among the people who enjoy music by various multimedia apparatus nowadays (as suggested in Kompenhans (2007)). Especially popular is the visualization of the music using the skillful graphic animation in the various media player software which moves on PC. A variety of graphic animations that stimulate the imagination to the momentary music are shown there in response to strength, the tempo, the rhythm, and the pitch etc. of music. However, even if the animation contains the signal wave form of the source music for instance as a design, it doesn't have the relation directly in the style, the mood, and the structure etc. of music. It is purely the graphical art by the designer of the player software. As a result, it may happen that the design of animation is quite similar in spite that the style of music is completely different. In the present study, the author has tried to make the progress of music visible not by real-time animation but by a still picture of a certain time unit of music while paying attention to its structural aspect.

2. Visualization of Musical Piece Structure and Similarity

As far as structural analysis of music is concerned, Foote (2000), Foote and Cooper (2001) and Cooper and Foote (2003) already proposed the visualization of time structure by auto-correlating some time-dependent variables of a piece of music. Isaacson (2003) also proposes the method of visualizing time-structural feature of music by analyzing the similarity of harmony or code progress pattern and the relating keynote array of the main musical part (main melody). In contrast to these, the author has tried to visualize the time- and harmony-structural features of music simultaneously by drawing a time-frequency chart of the music signal and putting it into a sort of graphic post processing. In addition, the time-frequency charts are cross-correlated between any two arbitrary music in order to image out the similarity in the direction of time axis and that of the harmony structure at the same time. The graphic post processing has been aimed at creation of an artistic work based on this type of scientific visualization results with the assistance of a popularly used illustration tool.

3. Results and Discussions

Although large varieties of music genre exist these days, musical pieces tested in the present work are picked up without any definite criterion from Western classic and East-Asian pops or folkloric music to which the author has easy access. The binary music data (wave file) is analyzed by FFT-Wave software establishing a clear time-frequency chart of the music signal. Figure 1 shows examples of such a time-frequency chart of music, representing Bach's prelude in C major (classical piano music), a Nepalese popular song "Euta manchhe ko mayale (Change due to love)", a Japanese Enka "First love train", South Korean movie theme music "Kiss", a Chinese (Nei Monggol) popular song "Meili de caoyuan wo de jia (My home in a beautiful prairie)" and Ravel's piano music "Sonatine" (again classical piano music). The original time-frequency chart in a Cartesian coordinates system has been transformed to spherical projection coordinates system bearing in mind that the periodic structure of the musical piece should be visually revealed. As for the color expression in this figure, the blue indicates higher levels of frequency power spectrum while the yellow and red indicate lower medium levels respectively.

On the other hand, Fig. 2 shows similarity maps obtained from the cross correlation analysis of arbitrarily-selected pairs of music illustrated in Fig. 1. In these maps, the gradation patterns in the horizontal direction indicate the similarity with respect to the time axis, and those in the vertical direction the similarity in progress of the music melody pattern and of the harmonics. The Western

classic music such as Bach or Ravel, partly because the genre is piano solo music, usually show relatively clear periodicity of the music signal in both time and frequency axes despite the composer's elaborate creative work. So any results of cross correlation with this category of music are apt to produce stripe gradation patterns of similarity which are parallel to the time axis. By contrast, the cross correlation with Chinese “My home in a beautiful prairie" usually show non-symmetric spectrum patterns with respect to the middle of the time axis, because of the abrupt addition of a tam-tam in the accompaniment. Therefore any cross correlation results with this music are more or less non-symmetric between left and right halves of the similarity map. The red gradation of this figure, indicating high levels of cross correlation similarity, is a good indicative of the music-to-music similarity highly dependant on the combination of the sampled musical pieces. From widely spread read parts in the final two similarity chart, one may conclude that the East-Asian pops or folkloric music, especially Nepalese song "Change due to love" and Nei Monggol popular song " My home in a beautiful prairie" have rather astonishing affinity to other type of Western or Asian music in spite of apparent difference in melody line and harmonics.

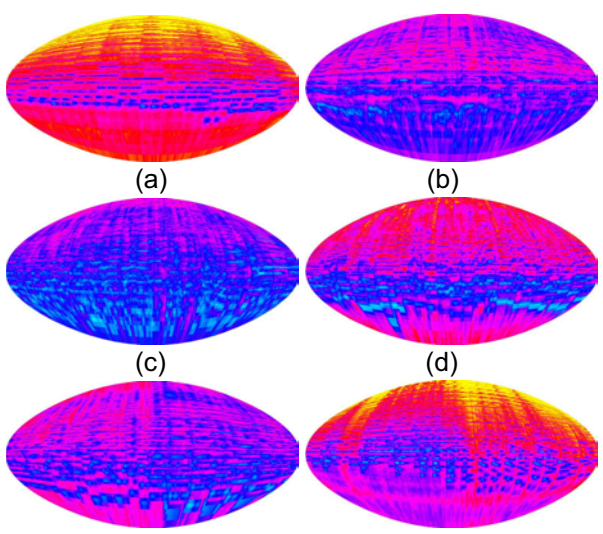

Fig. 1. Visualization of various genre of music: (a) Bach Prelude [Classical music], (b) Change due to love [Nepalese popular music], (c) First love train [Japanese Enka] (d) Kiss [Korean film music], (e) My home in a beautiful prairie [Nei-Mongol music], (f) Ravel Sonatine [Classical music].

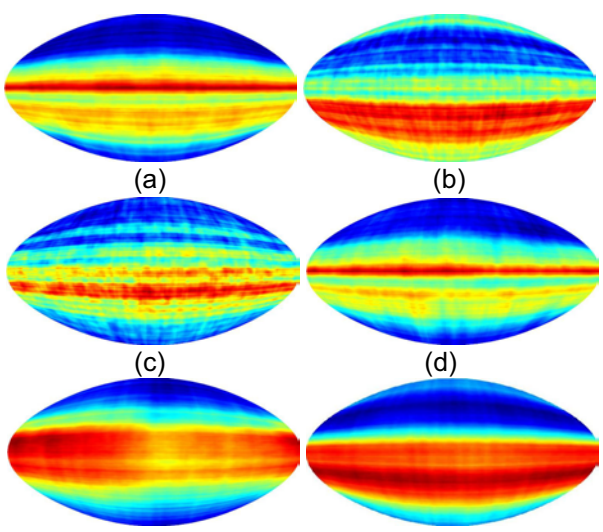

Fig. 2. Cross similarity of visualized music by a correlation analysis: (a) Bach Prelude *vs* First love train, (b) Change due to love *vs* First love, (c) First love train *vs* My home in a beautiful prairie, (d) First love train *vs* Ravel Sonatine, (e) My home in a beautiful prairie *vs* Ravel Sontine, (f) Change due to love *vs* Ravel Sonatine.

4. Conclusions

Cross correlation analysis has successfully demonstrated the time evolutional and harmony structural similarity existing between some popular music of different idioms and different origins from different Asian countries. Future works include cross similarity analysis of repeating musical phrases which may be carried out with other modified methods of music visualization.

References

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