Closed Patterns in Folk Music and Other Genres

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1. INTRODUCTION

In this extended abstract, we would like to present the concept of the 'closed pattern' from computer science and use it to investigate patterns in folk music. We also show how the quantity of patterns can be different comparing to other genres. We use three symbolic music databases: The Essen Folksong Collection (Schaffrath & Huron, 1995), The Jazz Tune Collection (Rodríguez López et al., 2015), and Bach's chorales (Sapp, 2005).

There have been lots of quantitative analyses on the Essen dataset (Huron, 1996; Bodet al. , 2002; Toiviainen & Eerola, 2001; Bod, 2002; Von Hippel & Huron, 2000). One central topic that appears in many of these analyses is the discovery of patterns. The difficulty of pattern discovery in music lies in the ambiguity of the term 'pattern'. With a rigid definition of what is a 'pattern', the process of extracting a pattern is comparatively easy. Here, we use the definition of pattern from MIREX (2015): a sequence which appears at least twice in a corpus is called a pattern.

Such a definition is very broad. For example, in a sequence of letters 'ABC ABCDE ABCDE' (the spaces are not included in the sequence), omitting the single letters which appear twice, we have 'patterns': AB, ABC, ABCD, ABCDE, BC, BCD, BCDE, CD, CDE, CDE, DE. However, from intuition, we can tell that, within these patterns, there are more important sequences: ABC and ABCDE. To capture this intuition, we borrow the definition of the 'closed pattern' developed in the computer science and data mining community. A closed pattern is the type of pattern which is more significant in terms of its length and repetitiveness, first proposed in (Pasquier et al., 1999). Intuitively, they are the patterns with the longest length and repeated the most frequently. Formally, a closed pattern is a pattern that is not included in another pattern which has the same support (or the number of sequences which contain the sequence in consideration).

In fact, people have used the closed pattern for analysing music in multiple occasions (Lartillot, 2005; MIREX, 2015), but as far as we know, there has not been research which systematically investigated the closed pattern of the Essen dataset and the Jazz Tune dataset.

In the case of music, we can treat each piece of music as a sequence of pitch-duration pairs. Nevertheless, such an arrangement is not able to capture the translation of pitches and the self-similarity of durations. For example, a pitch pattern of 'C4, D4, E4' and a pitch pattern of 'G4, A4, B4', in a general sense, should be considered as the same pattern since they have the same interval structure; a duration pattern of 'crochet, quiver, quiver' and a duration pattern of 'minim, crochet, crochet', similarly, should be treated the same. Therefore, we use the pairs of pitch differences and duration ratio as the input music pattern sequence, but not the simple absolute values of pitch-duration pairs.

Using the above definition of pattern and closed pattern, we present the number of closed patterns in three datasets of different genres. We also take one folk song from the Essen dataset and look at the specific closed patterns which were extracted. All the extracted patterns are available in .mid format per request.

2. RESULTS

Figure 1 shows the number of patterns and closed patterns we extracted using music from different genres: folk, jazz and classical. We can see that, although the ranges of the numbers of the patterns are similar, there is a big difference in the group variances. The classical Bach's chorales show a steady count of the number of patterns and closed patterns; the jazz pieces have the most uncertain amount of closed patterns; for folk music, we split the dataset into European and Asian groups to see if we could find any regional differences, but they are very similar both in range and variances, which are larger than the classical variance and smaller than the jazz variance.

Comparing the quantity of patterns and closed patterns, it is clear that using the definition of the closed pattern eliminates a certain amount of patterns. In addition, the variance differences of different genres are preserved regardless of patterns or closed patterns.

These observations on the ranges and variances help us establish the fact that the abundance of patterns and close patterns is universal across the three datasets of different genres.

Figure 2 is the example of a Chinese folk song. Figure 3 and Figure 4 show the closed patterns extracted from this specific Chinese song. As described in Section 1, we use the pitch difference and duration ratio pairs for the pattern extraction, so we do not have the absolute values of the patterns. Therefore, to re-construct the melody, we use the midi number 60, which is the note C4, as our first pitch, and a minim as our first duration. The information in the sequence of pitch differences and duration ratios is then used to generate the rest of the melody. We can see that the extracted melodies in Figure 3 and Figure 4 do have musical meaning.
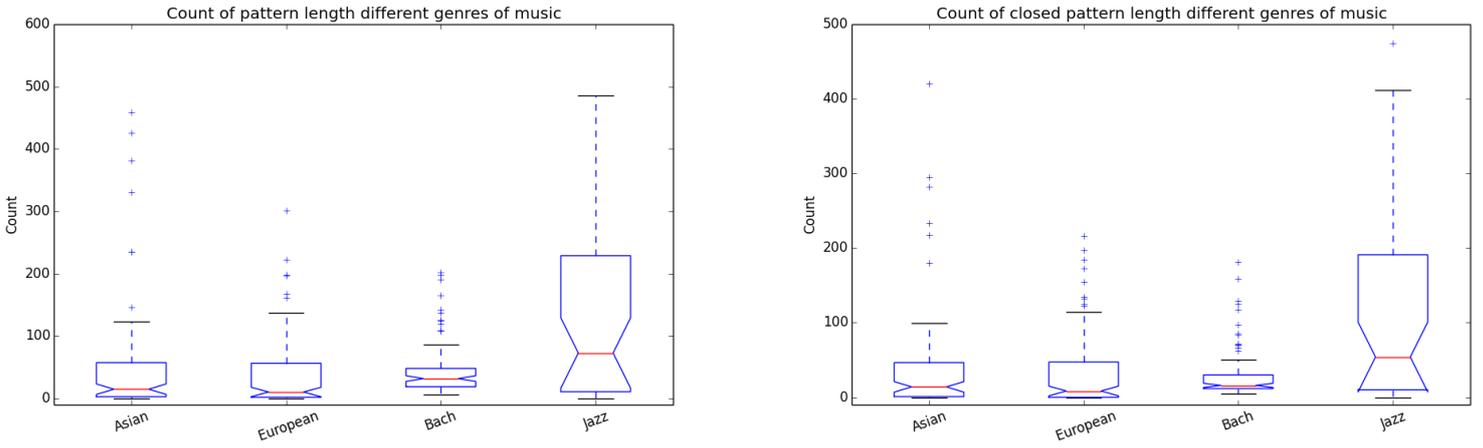
Figure 1: The number of patterns and closed patterns of different genres. For each x label, we use a hundred songs to calculate the number of the closed patterns. The y axis gives the count of how many patterns or closed patterns there are. The red line in the box plot shows the median of the distribution of the number of patterns across the hundred pieces. The four boundaries in the box plot indicate the Q1, Q2, Q3, Q4 of the distribution. The plus sign markers indicate outliers. The figure on the left shows the results of patterns, and the figure on the right is the results of closed patterns.
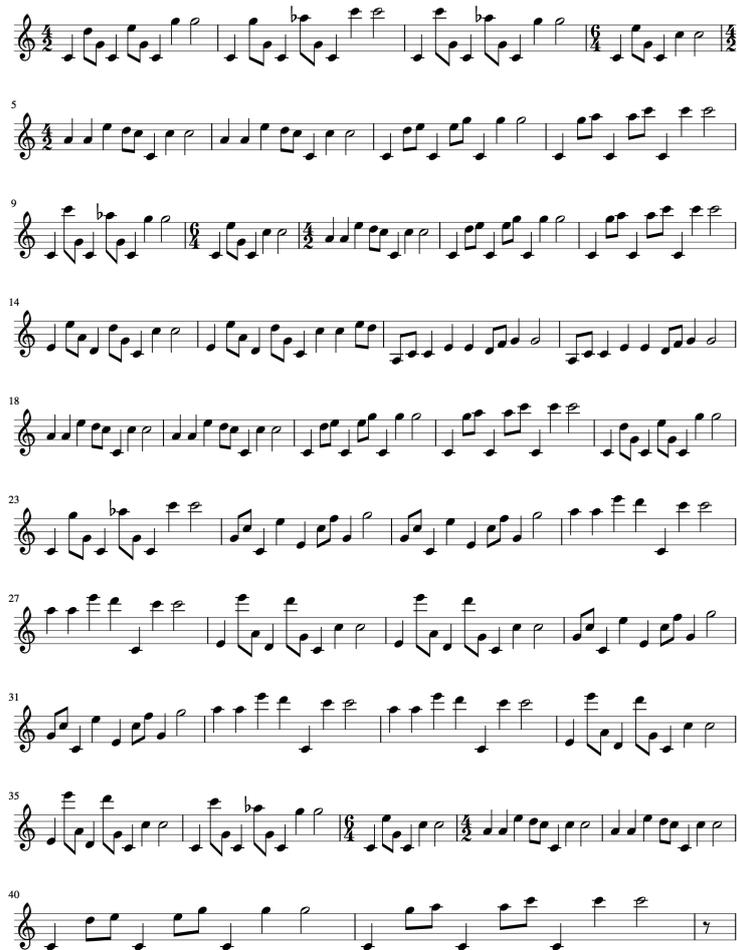
Figure 2: The example of a Chinese folk song.

Figure 3: Closed pattern extracted from the song in Figure 3.

Figure 4: Closed pattern extracted from the song in Figure 3.

3. DISCUSSION AND FUTURE WORKS

We used a rigid definition of the 'pattern' and the 'closed pattern' to investigate the patterns in folk music, and compared the results with other genres. We also showed some musically meaningful melodies extracted from the closed pattern definition.

With limited space, we could not show every pattern and closed pattern we extracted as they are numerous. Most musically meaningful patterns are covered in this definition of the pattern and the closed pattern, but there are ones which are less important. In the future, we hope to devise further conditions to restrict the amount of patterns, and make cross-genre and cross-region comparison.

4. REFERENCES

Bod, R. (2002). Memory-based models of melodic analysis: Challenging the gestalt principles. *Journal of New Music Research*, *31*(1), 27–36.

Bod, R. et al. (2002). A unified model of structural organization in language and music. *Journal of Artificial Intelligence Research*, *17*(2002), 289–308.

Huron, D. (1996). The melodic arch in western folksongs. *Computing in Musicology*, *10*, 3–23.

Lartillot, O. (2005). Efficient extraction of closed motivic patterns in multi-dimensional symbolic representations of music. In *Web Intelligence, 2005. Proceedings. The 2005 IEEE/WIC/ACM International Conference on*, (pp. 229–235). IEEE.

MIREX (2015). Discovery of Repeated Themes and Sections Results.

Pasquier, N., Bastide, Y., Taouil, R., & Lakhal, L. (1999). Discovering frequent closed itemsets for association rules. In *Database TheoryICDT99* (pp. 398–416). Springer.

Rodríguez López, M., Bountouridis, D., & Volk, A. (2015). Novel music segmentation interface and the jazz tune collection. In *Proceedings of the 5th International Workshop on Folk Music Analysis*, (pp. 99–105). CNRS.

Sapp, C. S. (2005). Online database of scores in the humdrum file format. In *ISMIR*, (pp. 664–665).

Schaffrath, H. & Huron, D. (1995). The essen folksong collection in the humdrum kern format. *Menlo Park, CA: Center for Computer Assisted Research in the Humanities*.

Toiviainen, P. & Eerola, T. (2001). Self-organizing map of the essen collection. *ISSCM 2001*.

Von Hippel, P. & Huron, D. (2000). Why do skips precede reversals? the effect of tessitura on melodic structure. *Music Perception: An Interdisciplinary Journal*, *18*(1), 59–85.