An Investigation of Music Genres and Their Perceived Expression Based on Melodic and Rhythmic Motifs

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Abstract. The constant growth of online music dataset and applications has required advances in MIR Research. Music genres and annotated mood have received much attention in the last decades as descriptors of content-based systems. However, their inherent relationship is rarely explored in the literature. Here, we investigate whether or not the presence of tonal and rhythmic motifs in the melody can be used for establishing a relationship between genres and subjective aspects such as the mood,dynamism and emotion. Our approach uses symbolic representation of music and is applied to eight different genres.

Keywords: music genres, melodic motifs, rhythm, mood.

1 Introduction

Online music data has significantly increased in number and size in the last decade. Specially, web radios and online stations have received much attention, due to recent research involving music recommendations systems applied for large-scale music collections. In this scenery, music genres together with mood in music are particularly interesting descriptors, since they summarize common characteristics of music and are included in the set of principal tools for content-based music retrieval and organization.

There are many previous works dealing with the task of automatic classification of music genres [1]. There is also some work related to the classification of mood in music [2]. Mood and emotion classifications are challenging tasks, since they involve subjective notions and face the difficulty of establishing an accepted taxonomy of mood and emotions.

The inherent correlation of music genres and mood have not been very much explored in the literature. In [3], the authors obtained substantial improvement in music emotion classification by including the genre information audio songs. The work of Hu and Downie [4] also explores the relationships of mood-genre, mood-artist, and mood-recommendation usages. They applied statistical analysis to metadata collections like *All Music Guide.com*, *epinions.com* and *Last.fm*,

demonstrating that important evidences in genre-mood and artist-mood relationships could be used in the development of a more succinct dataset of "mood-spaces" that minimizes redundant problems in emotional terms.

Within this context, the paper aims at contributing to the existing investigation of how music genres can be related with mood and thus establish complementary descriptors that can be used to improve current applications of music information retrieval systems. Our method is applied to MIDI files and based on derived temporal configuration patterns in the melodies of songs, also known as *motifs*. We analyse the presence of tonal and rhythmic motifs, demonstrating that they can be linked to the way we describe or feel a specific genre. Our motivation for analyzing the melodies is associated with the fact that the melody is one of the first music aspects that make us recognize a song. In addition, it is the contour of a melody what we usually first memorize from a song [5].

The remainder of the paper is organized as follows. Section 2 describes the method and the used dataset. Section 3 dwells the principal results and discussion. Finally, Section 4 presents the concluding remarks.

2 Methods

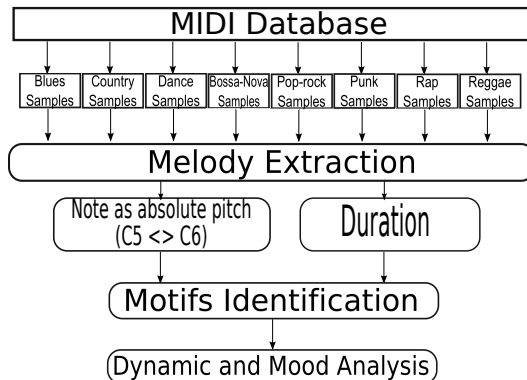The proposed method is summarized in Figure 1 and detailed in the following.

Fig. 1. The proposed method. After selecting MIDI songs from different genres, the voice related to the melody is extracted and represented by a vector of absolute pitches and by a vector of the note values. Absolute pitches are indicated as MIDI numbers. For example, C5 is 72 and C4 is 60. Note values are represented as relative durations (e.g. the eighth note takes the value 0.5 and the quarter note takes the value 1).

2.1 Data Description

Our database consists of eight music genres, namely, blues (34 songs), country (30 songs), dance (29 songs), bossa-nova (Brazilian music, 29 songs), punk (40

songs), pop/rock (39 songs), rap (5 songs), and reggae (12 songs). These genres are widely known and relatively easy to obtain as MIDI files in the Internet with a reasonable quality. We chose to use symbolic representation because it is a compact representation. Specially, the MIDI format offers the possibility of separating the melody voice, providing a deep analysis of the music elements.

To edit the MIDI files, the Sibelius software was used together with the free Midi Toolbox for Matlab computing environment [6]. The voice related to the melody (or singing voice) was extracted in each song and represented as a note matrix. Each column of the note matrix contains information about quantities such as the relative duration (in beats), MIDI channel, MIDI pitch, or intensity.

We propose to analyse the temporal patterns in the melody following two different procedures: considering the absolute pitch (AP), and the relative note value of the pitches (NV). For the AP representation the pitches are the events, for example, C4, D4, F#4, C5, D5 and so on. For the NV case, each event represents one possible note value, such as half note, quarter note, or eighth note. The relative note value is represented in this matrix through relative numbers (for example, 1 for quarter note, 0.5 for eighth note, 0.25 for sixteenth note and so on). In order to deal with possible fluctuations in tempo, we deactivated an option in Sibelius called "Live Playback". In this way, the note values in the MIDI file preserve their relative proportion (e.g., the eighth note is always 0.5).

To illustrate the idea, Figure 2 shows part of the melody of the song *"From me to you"* (*The Beatles*). The respective AP and NV vectors are also presented.

Fig. 2. An example of the representation of the melody of the song "From me to you" (The Beatles) using the AP (absolute pitch) and NV (note value) vectors.

2.2 Finding the Motifs

Music motifs (also known as "motives") are fundamental in music compositions. Basically, there are two forms of constructing music motifs: keeping the tonal sequence and changing the rhythmic structure; or keeping the rhythmic sequence and changing the tonal sequence. We consider both cases in this work. Due to repetitions and returns in popular music, it is also possible to find motifs that retain tonal and rhythmic sequences at the same time.

Our approach to find the tonal and rhythmic motifs in the melodies is relatively straightforward. In order to exemplify the idea, consider the AP vector from the melody in Figure 2. In the first step, we iteratively compare the AP

vector with shifted versions of itself. The comparison is done note by note, as illustrated in Table 1. The size of the motif is determined by the number of notes in the original vector that coincide with those in the shifted vector. For each shift degree, we count how many times motifs of different sizes occur. Table 1 shows that shifting this sequence by a lag of two results in three motifs of size one; while shifting by a lag of eight results in one motifs of size four, representing the main tonal and rhythmic motif of the adopted example.

```
AP vector   60 62 64 62 60 62 62 57 60 62 64 62 60 72 72 71
shift size 1  -  60 62 64 62 60 62 62 57 60 62 64 62 60 72 72
   match      -  F  F  F  F  F  T  F  F  F  F  F  F  F  F  T  F

AP vector   60 62 64 62 60 62 62 57 60 62 64 62 60 72 72 71
shift size 2  -  -  60 62 64 62 60 62 62 57 60 62 64 62 60 72
  matches     -  -  F  T  F  T  F  F  F  F  F  T  F  F  F  F

                ...
AP vector   60 62 64 62 60 62 62 57 60 62 64 62 60 72 72 71
shift size 8  -  -  -  -  -  -  -  -  -  60 62 64 62 60 62 62 57
  matches     -  -  -  -  -  -  -  -  -  T  T  T  T  T  F  F  F
```

Table 1. Examples of tonal motifs for the melodic sequence in Figure 2.

This process establishes a matrix that we denote as APM with rows and columns representing the shift iterations and the quantity of motifs of different size, respectively. For example, the entry APM(1,3) indicates how many motifs of size three occurred when the AP vector was shifted by a lag of size one. Finally, by calculating the average value of each column in this matrix, we obtain the average frequency that motifs of different sizes occurred in the melody of the corresponding song. Small motifs will not be used in our analysis since they do not necessarily represent a relevant repetitive patterns and are expected to have a highly random character. We arbitrarily consider motifs of size five or higher.

```
NV duration vector 0.5 0.5 0.5 0.5  1  0.5  1  0.5  3  0.5 0.5 0.5 0.5  1  0.5  1  0.5  3
    shift size 1     -  0.5 0.5 0.5 0.5  1  0.5  1  0.5  3  0.5 0.5 0.5 0.5  1  0.5  1  0.5
       match         -   T   T   T   F   F   F   F   F   F   T   T   T   F   F   F   F   F

NV duration vector 0.5 0.5 0.5 0.5  1  0.5  1  0.5  3  0.5 0.5 0.5 0.5  1  0.5  1  0.5  3
    shift size 2     -   -  0.5 0.5 0.5 0.5  1  0.5  1  0.5  3  0.5 0.5 0.5 0.5  1  0.5  1
      matches        -   -   T   T   F   T   T   T   F   T   F   T   T   F   T   T   T   F
                ...
NV duration vector 0.5 0.5 0.5 0.5  1  0.5  1  0.5  3  0.5 0.5 0.5 0.5  1  0.5  1  0.5  3
    shift size 9     -   -   -   -   -   -   -   -   -   -  0.5 0.5 0.5 0.5  1  0.5  1  0.5  3
      matches        -   -   -   -   -   -   -   -   -   -   T   T   T   T   T   T   T   T   T
```

Table 2. Examples of rhythmic motifs for the melodic sequence in Figure 2.

The rhythmic motifs are obtained following the same idea. Table 2 demonstrates comparisons for the Beatles' melody shown in Figure 2. Comparison of

Table 2 with Table 1 reveal that the information from rhythmic motifs differs from that brought by the analysis of tonal motifs. Shifting the sequence by a lag of nine, it is possible to find the main rhythmic motif of the sequence.

3 Results and Discussion

The presence of motifs was analised for each one of the eight genres. We first investigate whether or not the songs from different genres can be discriminated by the frequency of repeated tonal or rhythmic motifs in their melodies. We then explore the association of motifs with positive or negative emotions based on the link between music factors (rhythm, melody, and musical form) and emotions proposed in [11] (see summary in Table 3).

Rhythm	Regular/smooth	happiness, dignity, majesty, peacefulness
	Irregular/complex	amusement, uneasiness, anger
	Flowing/fluent	happy/gay, graceful, dreamy.
Melody	Wide melodic range	joy, uneasiness
	Narrow melodic range	sad, sentimental, delicate
	Stepwise motion	dullness
Musical form	High complexity	tension, sadness
	Low complexity	joy, peace, relaxation

Table 3. Expression of emotions according to different music factors: rhythm, melody and musical form [11].

As described earlier, we calculate the quantity of tonal and rhythmic motifs from different sizes for each genre. The tonal motifs bring information about the tonal contour of the melody. Predictable or modular melodies have constant contours, with many repeated parts. On the other hand, more dynamic contours are usually encountered in melodies with motifs that do not have a high degree of repetition. Figure 3 illustrates the countour of two different melodies, representing the genres blues and rap. While the rap melody is significantly regular, the blues melody is more dynamic and has many variations in the repeated parts.

The rhythmic contour of the melodies brings different information. Figure 4 presents the same examples as in Figure 3. The rhythmic structure in blues is significantly dynamic. Rap has a more regular rhythmic pattern, but it is interesting to note that the dynamics of its rhythmic contour differs from its tonal counterpart. Thus, we propose to link both aspects in order to correlate genre and mood. The mood annotations for the genres analysed in this work were mainly obtained from the *All Music Guide* site [7].

Figure 5 (a) and Figure 5 (b) show, respectively, the analysis for the tonal and rhythmic motifs. In both cases, we plotted the motif sizes against the average quantity of times it appears for each genre.
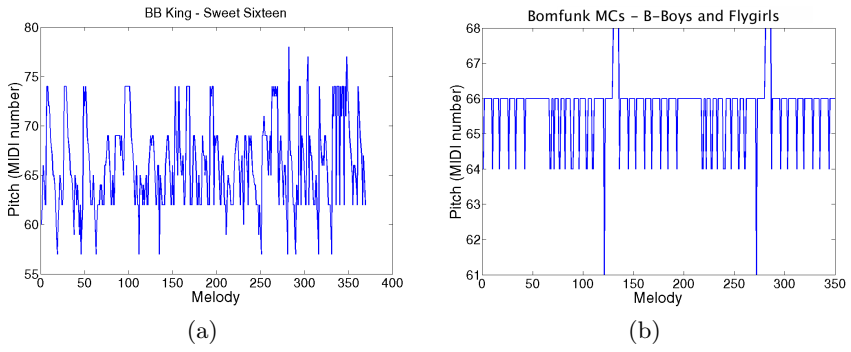
Fig. 3. The AP vector of two melodies. (a) A blues melody by the music *Sweet Sixteen* by *BB King* and (b) A rap melody by the music *B-Boys and Flygirls* by *Bomfunk MCs*.
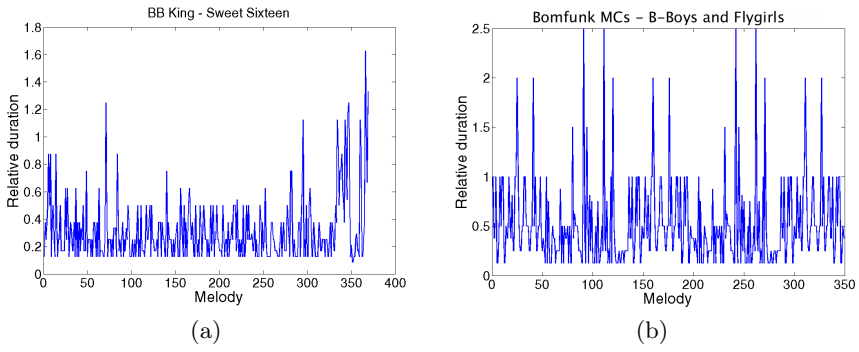

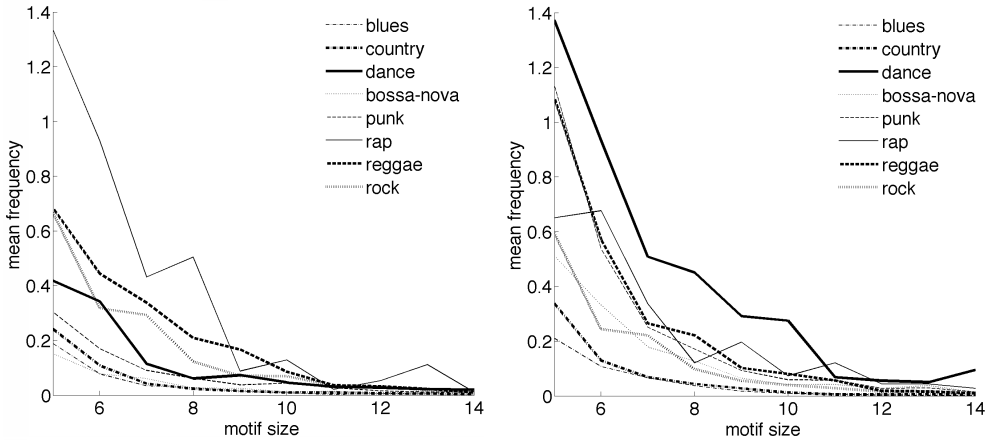**Fig. 4.** The NV vector for the melodies in Figure 3.

Fig. 5. The configuration of (a) tonal and (b) rhythmic motifs in the melodies of the music genres.

Rap has the higher quantity of tonal motifs, and the second higher quantity of rhythmic motifs. According to [8], rap is known by its chanted rhyming lyrics and regular flow. Rap artists generally receive mood annotations like cheerful, fun, exciting, harsh and angry. When compared to Table 3, the annotations agree with regular rhythm and flowing. Rapping consists of mainly three componentes: content, flow, and delivery [8]. "Flow" is related to the rhythm and rhyme aspects and how they interact, while "delivery" contains elements like pitch, timbre and volume and it is more related to the melody or the form the rap is sung. This may explain why rap has the second highest quantity of rhythmic motifs, differing from tonal motifs, since the tonal motifs mainly represents the spoken characteristic of the genre. The delivery may contain more irregular components, which may contribute to the negative annotations. Rap was influenced by reggae [8]. They share common characteristics like the syncopated and regular rhythms. The melody of reggae is characterised by a simple feel and sense of phrasing [7]. This agrees with the results, since reggae is the second higher in presence of tonal motifs and the third higher in the presence of rhythmic motifs. Common annotations for reggae albums are relaxing, restrained and soothing.

Dance is the most rhythmically repetitive genre in the results. While the tonal sequence may present some variations, dance music has a defined rhythmic beat. This is in agreement with the mood annotations found in [7] such as energetic, happiness and lively. The constancy and modularity in dance music determines its intrinsic attribute: a steady rhythm that stimulates body movements.

Blues and country genres usually do not aggregate many repeated motifs in their melodies, either in tonal or rhythmic aspects. Both genres receive annotations like complex, sophisticated, sentimental and stylish. Country and blues share similar themes and songs, since blues was a stylistic origin of country. The melodies of both genres are characterized by the selection of specific notes (for instance, the flattened third, fifth and seventh) and narrow melodic sequences [10]. This contributes for annotations like sentimental or melancholily. Country songs are formed in simple chords and a plain melody, but these basic forms allow a substantial range of variations and different styles, from resolved patterns to improvisations [7]. This is reflected in the results, since country and blues have a small quantity of repeated motives when compared to the other genres.

Rock music has a defined rhythmic structure but it is usually more dynamic than, for example, dance. Common annotations for rock albums are: energetic, ambitious and exciting. Although referred here as a genre, punk is also known as a rock style, with basic chords progressions and simple melody (played in a louder and faster manner [7]). This is reflected in the results, mainly in the rhythmic analysis of the melody, since punk seems to have a considerable number of rhythmic motifs.

Bossa-nova is a kind of Brazilian music originated from jazz and samba. It is harmonically complex, but its melodies have a constant rhythm [10]. This explains why it is similar to rock when analyzing the rhythmic motifs. However, the lyrics in bossa-nova are usually richer than in rock in terms of tonal variations [10], an aspect well captured by our results regarding the tonal motifs.

4   Concluding Remarks

We proposed a link between music genre and mood using the presence of melodic motifs in the songs. The melody or vocal track is extracted from MIDI files and represented by a vector of note pithes and note values. We derived a method to identify tonal and rhythmic motifs in each melody and relate the frequency of their occurrence to mood notions. For validation purposes, we collected mood annotations from artists in our dataset using the *All Music Guide* site [7].

Genres like rap, dance, reggae and rock, known for their constant rhythmic patterns were found to have a higher quantity of motifs in their melody. Blues and country confirmed their fame to be "more sophisticated" genres, since it is not common to find many motifs that are fully repeated. We expect that such kind of information can help to improve music-content classification systems.

This work represents the first steps of a deeper study which will include a more complete examination of genres and other evaluation methods. In principle, it would be relatively straightforward to include other characteristics of songs in our analysis, such as rhythm of the percussion tracks and instrumentation.

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