Visualizing Musical Structure of House Music

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Abstract. This paper describes a simple method for visualizing the musical structure of house music. A given audio signal is separated into drums, bass, vocals, and others, and then the sound pressure of each instrument part is calculated and visualized. Using those sound pressures, the audio signal is segmented into four sections: intro, drop, break, and outro. A preliminary analysis revealed that the drums and bass have a significant impact in delineating musical structure.

Keywords: House Music, Musical Structure, Music Analysis, Visualization, RMS, Audio Segmentation

1 Introduction

House music is a type of dance music that has a different structure from that of popular music. Whereas popular music often makes a structure by changing the characteristics of the melody and chord progression, house music enhances groove by repeating the same music loops and creates movement by adding new music loops and/or removing the added music loops.

Visualizing such a structure of house music will provide an opportunity for a deeper understanding of individual pieces. Therefore, we aim to develop a system that provides useful information to composers and DJs by analyzing and visualizing various house music pieces.

There have been many methods for visualizing musical structure in musical compositions, such as those based on a self-similarity matrix[1], a greedy search algorithm[2], and pattern matching of note sequences[3]. However, a house-specific method has not yet been proposed.

This paper describes preliminary results of visualizing the musical structure of house music. A given audio signal is first separated into drums, bass, vocals, and others, and then their sound pressures are calculated. By visualizing the sound pressure of each instrument part, it enables the user to grasp the musical structure.

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2 Proposed System

Although no clear definition exists for the designation of musical structure in house and other dance music, this paper defines the following four sections.

- Intro: Introductory section of a song
- Drop: The climax of the song
- Break: The part of the song other than the climax
- Outro: The end of the song

The drop corresponds to the 'chorus' in popular music, and the break is similarly positioned to the interlude after the chorus or verses A and B before the chorus. In house music, new sound materials called music loops are often added to give the music a more lively feel. Therefore, the musical structure as described here is expected to be highly related to sound pressure.

2.1 Pre-processing of sound sources

From a given audio signal, t the sound source for each part (drums, bass, vocals, other) is extracted. We use Demucs for sound source separation. The sound source format is mp3 and the bit rate is 320 kbps, and the sampling frequency is 44.1 kHz.

2.2 Calculation of sound pressure for each part and unseparated sound source

The sound pressure is calculated as the root mean square (RMS) of the waveform of the target sound source. Specifically, the sound pressure $S_i(t)$ at waveform $y(t)$ is expressed by

$$S_i(t) = \sqrt{\frac{1}{T}\sum_{\tau=0}^{T} y(t+\tau)^2 dt}$$

where i denotes the part ($i \in \{\mathrm{drums}, \mathrm{bass}, \mathrm{vocals}, \mathrm{others}, \mathrm{mixed}\}$). The window width T for calculating RMS was set to 65000 samples, and the time resolution (time interval of $S(t)$) was set to 16250 samples.

The RMS is calculated using Librosa, a Python module for music analysis. The RMS values of each part are then normalized so that the maximum value of the pre-separation source is 1 and the minimum value is 0.

2.3 Drawing Graphs

Using $S_{\mathrm{bass}}, S_{\mathrm{bass}}, S_{\mathrm{vocals}}, S_{\mathrm{others}}$ as well as RMS of the pre-separation source S_{mixed}, the audio signal is segmented into four sections (Intro, Drop, Break, Outro) The judgment criteria for each section are as follows.

- Intro (yellow): The section from the start of the song to the time when S_mixed first exceeds 0.85

- Drop (red): The interval where S_mixed exceeds 0.85
- Break (green): Interval when S_mixed is below 0.85 (excluding intro and outro)
- Outro (blue): the interval from the last time when S_mixed exceeds 0.85 to the end of the song

This criterion is based on the hypothesis that the drop corresponding to the chorus is basically louder than the other sections; the threshold of 0.85 was determined experimentally by testing several songs.

3 Preliminary Results

We conducted a preliminary experiment on visualizing house music using the method described in Section 2. The following songs were used.

Piece 1 Selecao - Mark Knight, Shovell
Piece 2 Phoenix - Daft Punk

The results are shown in Figs. 1 and 2.

Fig. 1. Selecao - Mark Knight, Shovell

For Piece 1 (Fig. 1), we can see that the four sections are appropriately divided and that some instrument parts enter and/or leave at the boundaries of the sections. For example, the sound pressure of the drums and bass increases when switching from the intro to the first drop. In the middle of the piece, the drums and bass leave as soon as the drop is over, the vocalist enters, and in the next drop, the vocalist leaves again and the drums and bass enter. This piece has a typical structure of house music, so the visualization is generally functioning.

On the other hand, Fig. 2 shows that almost all sections were segmented into the drop. This is because the drum sound continues with high sound pressure and it makes the sound pressure of the mixed (pre-separation) source very high in almost all sections. This implies that more sophisticated criteria will be needed to improve the judgment of the musical structure.

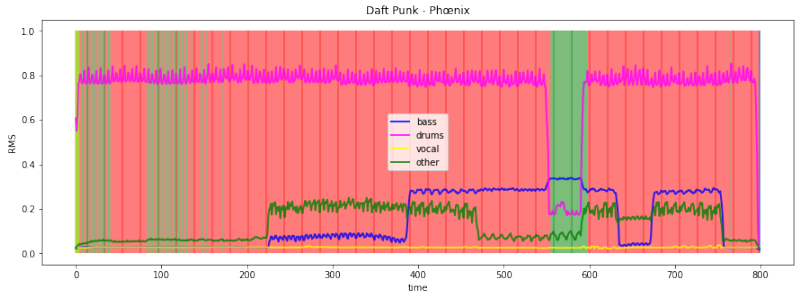

Fig. 2. Phoenix - Daft Punk

In those two pieces, drums and bass are always played during the drop section, indicating that these two parts have a significant influence on the sound pressure. Otherwise, the bass does not sound in most of the break sections, indicating that the bass tends to leave at transitions from the drop to the break. From those observations, we can consider that the drums and bass play an important role in house music to make movement from one section to another section.

4 Conclusion

In this paper, we attempted to visualize the music structure of house music by drawing the sound pressure of each instrument and by coloring sections judged with the sound pressure of the pre-separation sources.

The preliminary experiments revealed some influences of each part on the musical structure. In particular, drums and bass play a role in transitions of sections (e.g. entering and leaving the drop) in house music.

In the future, we plan to visualize richer information, such as detailed drum patterns obtained with a drum transcription technique. In addition, we have to make more sophisticated criteria to decide section boundaries, for example, using a technique for detecting repetitive patterns.

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