Motion Scoring

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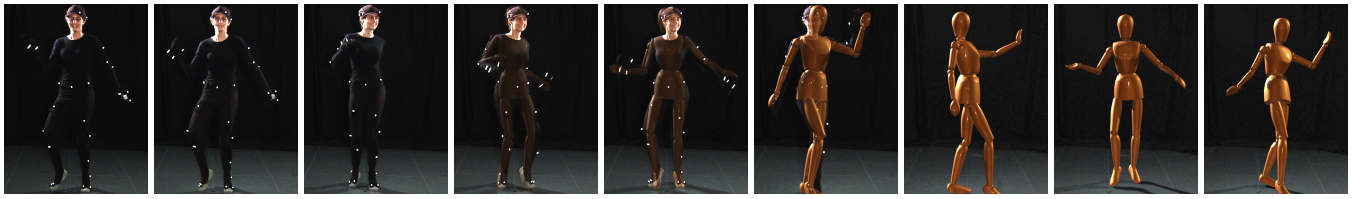

1 Motivation

The one-way road leading music to motion has many manifestations. Choreographers build dance movements to match music features, subway passengers tap their feet following their iPod song hits, and the number one rule at any party is: if you wanna dance, dance to the music!

This relation has also been used to create motion in order to bring characters to life. The large human motion database, made available by the widespread of Motion Capture technologies, has encouraged researchers to investigate new methods for creating animations from pre-recorded movements. In this context, music is a natural guiding method for motion synthesis [Kim et al. 2007].

But why not the other way around? In film scoring, for instance, music is composed based on visual action, and in video games, the intensity of the soundtrack varies according to the player's performance. Hence, the direction motion-to-music is feasible. However, to the best of our knowledge, motion has only been used to guide music composition using low level commands [Dobrian and Bevilacqua 2003].

The intention of this work is to introduce minimal conditions that allow a dance-guided music composition. In what follows, we describe a method in which a measure-synchronous motion graph is used as a tool to guide the concatenation of musical phrases for the composition of a new song.

2 Score Building

A central issue that has to be studied is how to relate motion to music beats. A computational analysis of how abrupt changes in the movement direction and acceleration are related to music rhythm requires the establishment and quantification of a large number of parameters. We circumvent this problem by exploring the human ability to instinctively relate both motion and music signals. In our approach, MoCap is done while a dancer performs to the songs in the database, automatically connecting these signals.

The fist step is to compose samba style songs, each with a different melodic instrument. The songs are metrically organized in measures, which determine the size of the melodic phrases. The latter are composed based on high level parameters, such as the number of notes and the current chord being played.

While a dancer performs to each of the music pieces, motion capture technology is used to record the movements. This way, the motion is automatically synchronized with the music and, hence, can be naturally segmented according to the melodic phrases.

A measure-synchronous motion graph is then built by observing segment boundaries similarities. We used the similarity metric described in [Kovar et al. 2002]. The end of each motion phrase is connected to the five nearest segments, creating a directional weighted graph.

A restricted random walk on this graph creates a new motion. We observed that two restrictions are appropriate for the resulting music to resemble samba style pieces. First, musical instruments should not vary too frequently. In our implementation, this is guaranteed by dynamically varying the weights of the graph edges during the walk. Second, it is important to observe intensity variations between large music blocks during composition. We used three distinct blocks, and motion phrases were annotated accordingly. During motion synthesis, the user can specify the number of phrases desired for each block and the order in which they occur.

The large number of connections in the graph is combined with a weighting system to prevent the walk from reaching the last phrase of each clip, which would be a dead end. Nevertheless, after the total number of phrases has been concatenated, a restricted graph search allows quickly reaching the last phrase.

Once the new dance is synthesized, the corresponding melody score is composed by following the high level parameters corresponding to the segments used. The chord progression is kept and the drum loops are adjusted to match the generated motion. We notice that in the samba style, feet movements are more intense in the presence of the tambourine. This behavior is automatically preserved by observing the presence of drums in the original music phrases.

3 Future Directions

This work indicates that motion can be used to create music in non-trivial ways. Further directions in this field include exploring more sophisticated kinds of musically-consistent motion segmentations and analyses. The relation between melody and mood is well known by music theorists and the association between mood and motion can be inferred from the concept of body language. Therefore, understanding mood as a link between melody and motion would be an interesting topic for further investigation.

References

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