

Drawing-in effect on perception/cognition of musical beats and visual beats

Yoichi Nagashima

Department of Art and Science, Faculty of Design
Shizuoka University of Art and Culture

nagasm@computer.org

Abstract

This research is related to the interaction in the perception and cognition of musical beats and visual beats. Like a "music promotion video", the case where the beat of music and images synchronizes completely, it is generally natural and comfortable for people. In this research the tempo between images and music is slightly different. Merely, slightly, when it has shifted, man is moving the interpreting point of a beat in time unconsciously, and the synchronization of beats is considered that it is going to keep on enjoying a synchronization. If the interpreting point of coincidence of the beats which moved in time becomes still larger, man changes the interpretation of a beat to the reverse side beat of a music beat, and seems to enjoy the feeling of a synchronization to the last. I produced the experiment system to generate visual beats and musical beats with slightly different tempo in real-time, and tested with many human subjects.

1. Introduction

Murao classified how to feel a music beat into the following three kinds [1]. "Tago Beat" is a beat remarkable in Japanese people, and is how to feel the beat struck and stopped at a landing point (Fig.1).

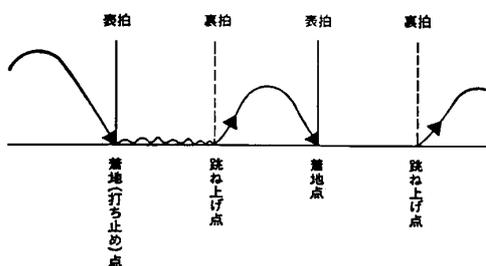


Figure 1 : Tago Beat

"Toe Beat" is a beat remarkable in Europeans and Americans, and is how to feel the beat which has bounded immediately at the landing point (Fig. 2).

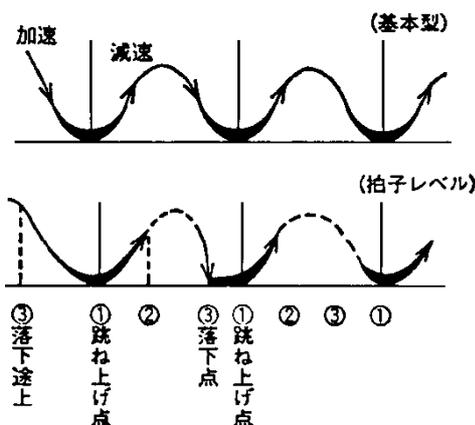


Figure 2 : Toe Beat

"Heel Beat" is a general beat at Rock Music or Pops, and is how to feel the beat thrown linearly (Fig. 3). In this research, in order to see the relation between the beat of images and musical beat, the object was limited to this "Heel Beat."

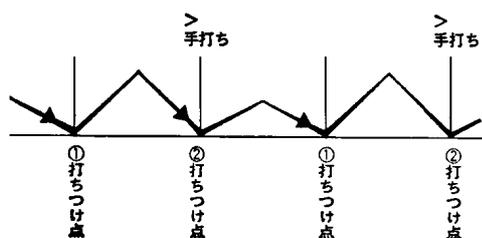


Figure 3 : Heel Beat

2. Model of "Drawing-in Effect "

I produced one movie work called "JizoGazoDazo" in 2002. With this work, the music of five beats of a background and the beat of the image which still pictures transformed with "Morphing" by regular intervals are perceived. Fig. 4 shows this situation and man can enjoy the synchronization of a musical beat and the beat of the point of still image.

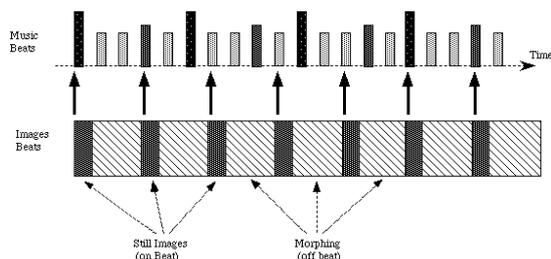


Figure 4 : Beats in "JizoGazoDazo"

Although, as for this music, tempo is changed delicately strictly, since the tempo of an image does not change at all, the position of the beat of an image and a musical beat shifts gradually. Fig. 5 shows this situation, and man is considered to move time width permissible as a music beat unconsciously in order to interpret a nearby music beat as a position of the music beat corresponding to the beat of an image.

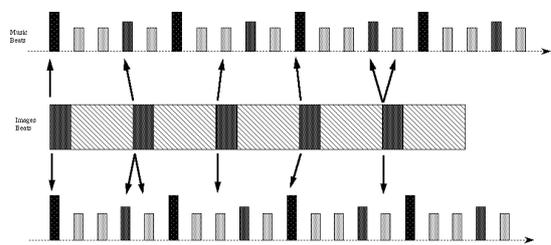


Figure 5 : Beat shifts in "JizoGazoDazo"

3. Design of psychological experiments

Fig.6 shows the system of the psychological experiments which I designed with prudent considerations about latency. A subject watches and listens to an image and music simultaneously, and taps a switch according to a beat.

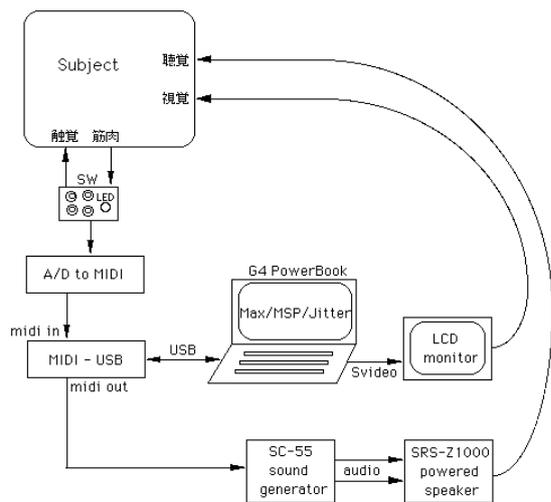


Figure 6 : System of the psychological experiments

The system is constructed in Max/MSP/Jitter system. Fig.7 shows the main patch of the experiment system. Since it omits on account of space about work of the image material and a music material for the experiment, please refer to [2] and [3].

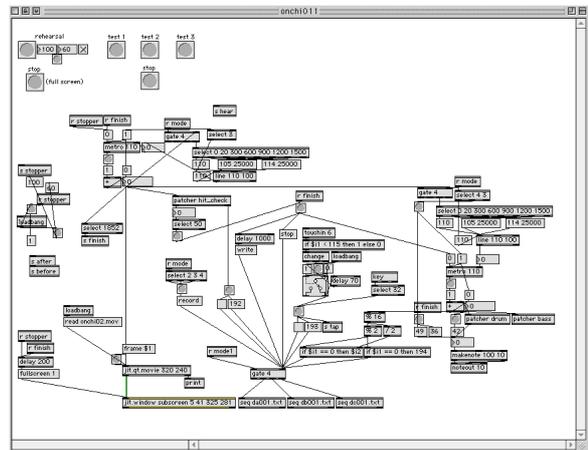


Figure 7 : Main patch of the system

A subject observes the movie of a front LCD monitor. He (she) relaxes and listens to the background music which a stereo monitor sounds simultaneously. He (she) taps favorite one out of four switches of the gained switch panel at the moment of the stillness which is an image beat. An experiment consists of following four : (1) The rehearsal for getting used to tap, (2) The experiment mode 1 which tap with the guide sound which shows an image beat, (3) The experiment mode 2 which guide sound is lost and tap to actual movie, (4) The experiment mode 3 which is the same situation as experiment mode 2 for a subject. Fig. 8 is the photograph of this experiment scenery.



Figure 8 : Photo example of the experiments

Experiment mode 2 and experiment mode 3 are the length for about 3 minutes. Systematically, in the

experiment mode 2, the interval of a music beat is strictly changed slightly to an image beat at equal intervals. In experiment mode 3, the interval of an image beat is strictly changed slightly to a music beat at equal intervals by this contrary.

4. Results of experiments

A subject is a total of 43 persons of the student of SUAC (Shizuoka University of Art and Culture), and the personnel. The subject was roughly divided into two groups as a result of the experiment mode 1. In a group named the "beginner group", as shown in Fig.9, in spite of having taped the image beat at equal intervals with guide sound, the errors were roughly distributed.

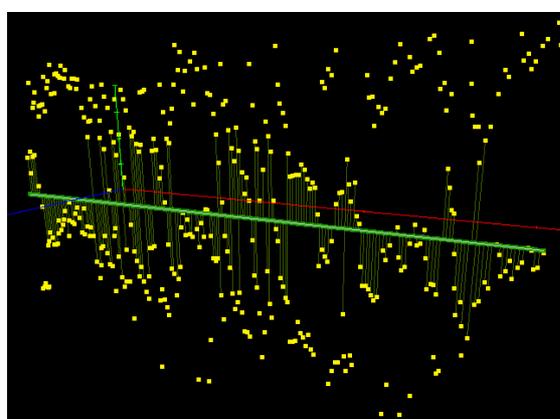


Figure 9 : Example result of "beginner group"

In a group named the "expert group", it taped correctly with the small error to the image beat at equal intervals that it seems that it is shown in Fig.10. Only the experiment result data of this group were made to inquire in experiment mode 2 and experiment mode 3.

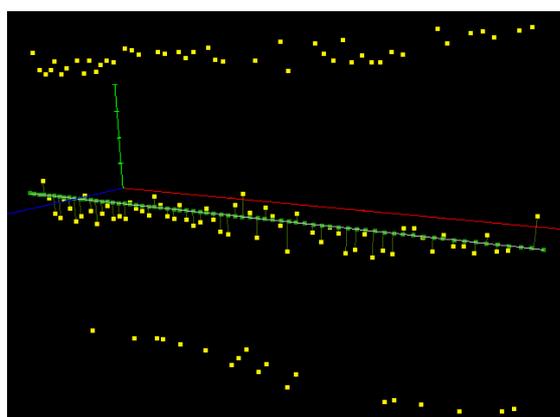


Figure 10 : Example result of "beginner group"

4.1 3-dimensional visualization system

The 3-dimensional visualization system of experiment result data was developed using Max/MSP/Jitter as some experiment systems. Fig. 11 is 3-dimensional visualization of data as a result of the experiment mode 2 to one of the subjects of an "expert group."

The dot of green at equal intervals shows the position of an image beat. The dot of yellow shows the position of a subject's switch tapping, and shows the error from the image beat of a standard in the vertical direction. The dot of a light blue and blue shows the position of a music beat, and having waved gently means that tempo is changing very slightly.

This 3-dimensional display can be arbitrarily moved in a horizontal direction and the vertical direction, or can be expanded. Moreover, a viewpoint can also be rotated arbitrarily.

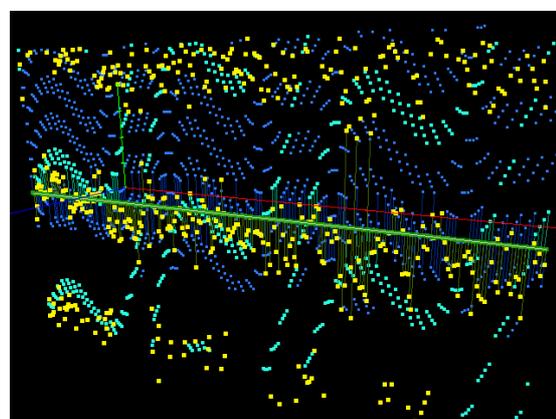


Figure 11 : Result data of experiment mode 2

4.2 Drawing-in effect

Fig. 12 is the example to which some data of an experiment result was expanded.

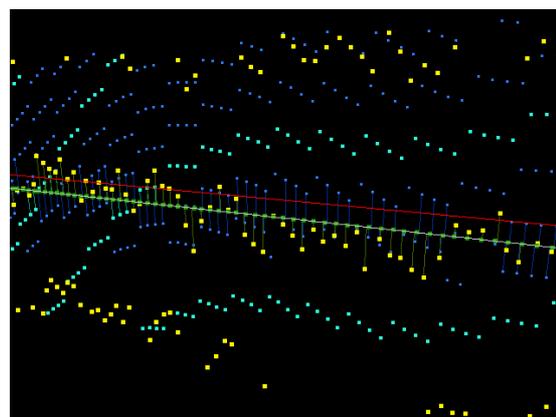


Figure 12 : Zoom-up data of result data

Please observe the data near the center of a screen. Since this subject is performing exact tapping at equal intervals to the image beat, the dot of yellow is distributed near the dot of central green. Since the light blue which shows the beat of background music on the other hand, and the dot of blue are slowed down very slightly from the slight difference in tempo, they have been located in a line in the direction of the lower right.

And for what should be observed, since it was unconsciously influenced by this music beat, the dot of yellow is "drawn-in" slightly from the dot of green to the direction of the lower right.

Of course, since this subject is an "expert group", if the distance which was influenced by the music beat and is separated from the dot of green becomes large, a music beat will be changed unconsciously and it will be small without error again.

Consequently, the yellow dot of tapping becomes parallel to the row of a music beat, and repeats arrangement that even the axis of green returns rapidly in a certain place. The dot shows form like "the tooth of a saw."

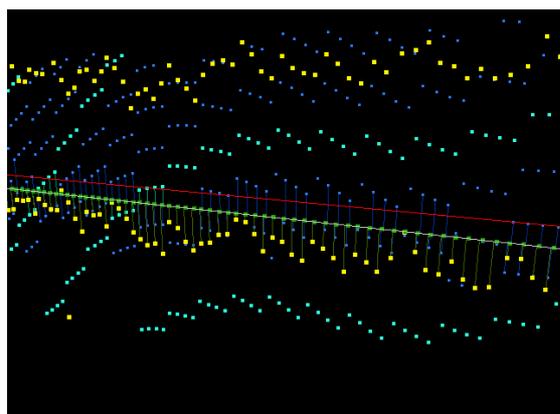


Figure 13 : Another subject's result data

Fig. 13 is the enlargement of another subject's experiment result data. Here, a yellow dot like "the tooth of a saw" which shows "Drawing-in effect" which was looked at by Fig.12 can be found out clearly.

5. Discussion

In the experiment of this research, the characteristic of movie material is important. In the image of this experiment, between the beat is connected by making a still picture into an image beat by Morphing which changes smoothly, and the beat which next appears can be expected. In order to verify this effect, the next supplementary experiment was conducted. Replacing only an image material as a difference, all

other conditions are the experiments conducted the same. It considered as the state where the still picture which does not have Morphing at intervals of the same time as an image changes momentarily, the thing of a type which is completely different at random appears, and a subject cannot do the photograph as for prediction.

As a result, some data is shown in fig.14. Although this subject showed Drawing-in Effect to the image of Morphing, the tendency was extinguished in this experiment. Furthermore, as what should be observed, this subject was sitting down calmly in the experiment of a Morphing image. However, just as it became this experiment of a change image at the moment, it appeared in the act of moving the body and a leg greatly unconsciously and taking a beat.

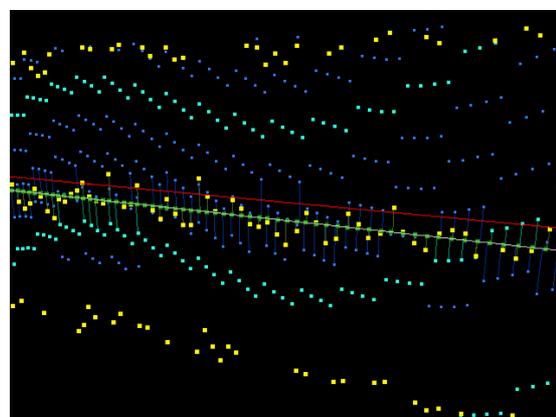


Figure 14 : Result of the supplementary experiment

6. Conclusions

This paper showed the interaction in the perception and cognition of musical beats and visual beats. I produced the experiment system to generate visual beats and musical beats with slightly different tempo in real-time, and tested with many human subjects. While some interesting experiment results were obtained, the subject which should be studied further from now on was also found out. I want to continue to advance research of "beat".

References

- [1] Tadahiro Muraio, *Discovery from "Tago Rhythm" (in Japanese)*, Research of Musical Education 56, Ongaku-no-Tomo, pp.177-190, 1988
- [2] Yoichi Nagashima, *Drawing-in Effect on Perception of Beats in Multimedia (in Japanese)*, <http://suac.net/nagasm/ASL/beat/>
- [3] Yoichi Nagashima, *Art and Science Laboratory (in Japanese)*, <http://nagasm.org>