Relation between motion and emotion for the snare drum performance.

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ABSTRACT

I want to find out the mechanism of the performance motion by analyze the professional drummer of motion. It will be the guidance of the method of education such as the performance progress by elucidating the mechanism. So I thought whether I could not utilize in educational technique by analyzing this motion data in detail. Therefore, using same as the Sato's data, I analyzed the movement of the stick by some analytical approach. I examined how to use stick of the professional drummer using it, which analytical approach was speed, an angle change, and standard deviation. This study was able to show easily understand form by visual-izing the relations of emotion. Using this result, I can make use for amateur training in future. Therefore I think that this study was significant.

INTRODUCTION

Until now, it have been done by various musical instruments and training different, in the study of music representation and communication of emotion [1] [2] [3] [4]. These studies were suitable as method of verification that how to communicate and perceive for the listener. However, performar of get a physical and performance is very confusing how to communicate for the listener by the difference of performance motion. In addition, the musical emotion has many ambiguous expressions like an expression mark. This case have much to the instruction of performance for musical emotion, too. For various reasons, I thought that it has necessary to objectively evaluate the musical performance.

Therefore I measured motion of the performance using the motion capture system, and I considered to the association between impression and motion of the musical performance expression [5] [6].

Mito's study [6] had evaluative of the impression for the performance, that two drummers of the different carrier were peformed by several emotion patterns. As a result, it was correlated intention of the performance expression and performance motion. I underatood that the performer changed motion in detail to purposive perform. And I understood that it influenced the personal technic than a carrier, that about the communication of the performance expression. In addition, I understood that the speed of the both hands and standard deviation (S.D.) of the both arms has an influence on difference of the image of active and calm.

In addition, Sato [7] investigated to correspondence relation between the performance motion and the emotion by the motion capture system in snare drum performance of intended expression.

They examined correspondency during the performance motion and the emotion in snare drum performance for the five basic emotions and emotionless by the emotional space of Juslin [1].

As a result, it was understood correspondency during each emotion and the height of stroke, the speed of the downstroke, the speed of the upstroke (Figure 1).
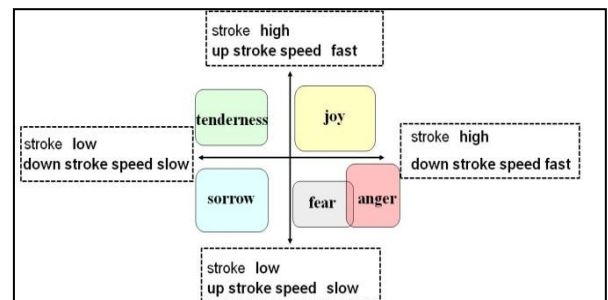

Figure 1. The relationship between the combination of the motion cue and the five emotions.

They did two axes corresponding to axial activity (axis I) and valence (axis II) suggested by Juslin [1], The motion cue for the axis I was the height of stroke and the speed of downstroke, and the motion cue for the axis II was the height of the stroke and the speed of upstroke.

I thought whether I could not utilize in educational technique by analyzing this motion data in detail. Therefore, using same as the Sato's data [7], I analyzed the movement of the stick by some analytical approach. I examined how to use stick of the professional drummer using it, which analytical approach was speed, an angle change, and S.D..

EXPERIMENT

Experimwnt summary

I showed a performance task in Figure 2. For two performance tasks, I instructed to snare drum performance for five emotions of "joy, tenderness, sorrow, fear, and anger". One

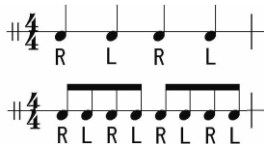professional drummer performed for the tempo 90bpm and 120bpm during the one minute.

Figure 2. Performance task

Task

Before performance, I instructed the kind of emotion, pattern of the beat (quarter note and eighth note) and tempo for a player. I rang the metronome sound from speaker during two bars of the before performance, and the after, she started to performance. I showed the summary of metronome and the performance in Figure 3.
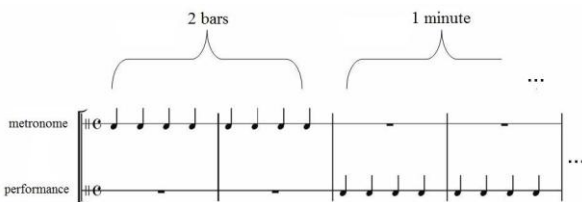

Figure 3. The summary of metronome and the performance

Environment of the measurement

Measurement was performed by the digital optical motion-capture system, MAC 3D System of Motion Analysis. Frame speed was 1/200s and shutter speed was 1/1000s. The markers were attached on the upper half of the body. Moreover, since the relation between a motion of a stick and the head of a snare drum was also needed, 2 markers were attached on the tips of both sides' sticks, and 3 markers were done on the head of the snare drum. The total of the marker was 30 pieces (Figure.4).
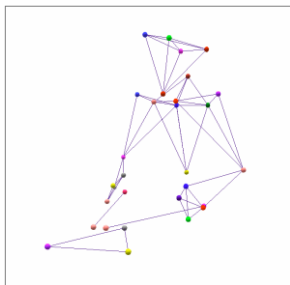

Figure 4. Position of markers

Analytical approach

The analyses were mean speed, mean angle and mean S.D.. The analysis section was form the highest point (Z-axis) of stick which was thrown up at the time of 1st drumming to the next highest point where stick bounced back after hitting the head of a snare drum. From three-dimensional coordinate marker of the stick tip, I calculated the mean speed and mean angle of each marker for the one frame. I showed the formula (1), (2) that speed v_i and angle ϕ for the frame of i in three-dimensional coordinate (x, y, z).

$$v_i = \sqrt{(x_i - x_{i+1})^2 + (y_i - y_{i+1})^2 + (z_i - z_{i+1})^2} \tag{1}$$

$$\phi_i = \frac{(x_i x_{i+1} + y_i y_{i+1} + z_i z_{i+1})}{\sqrt{(x_i^2 + y_i^2 + z_i^2)(x_{i+1}^2 + y_{i+1}^2 + z_{i+1}^2)}} \tag{2}$$

From the calculation result mentioned above, I calculated each mean. In addition, the S.D. value of the speed is high when the speed becomes fast. Therefore I analyzed it in the ratio of speed and standard deviation.

RESULT

Speed, angle and S.D.

I showed the mean speed, mean angle and mean S.D. of the stick tip of right and left for the each performance pattern (Figure 5-Figure 7). And these results showed to the Table 1.
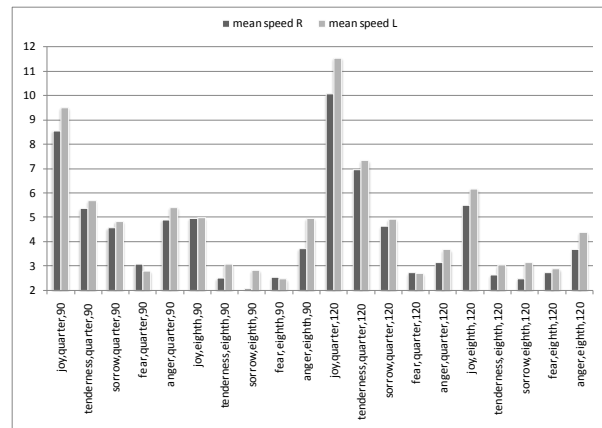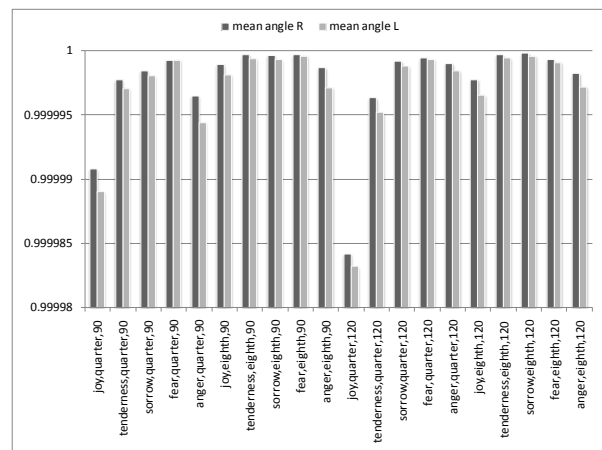

Figure 5. The mean speed of each pattern

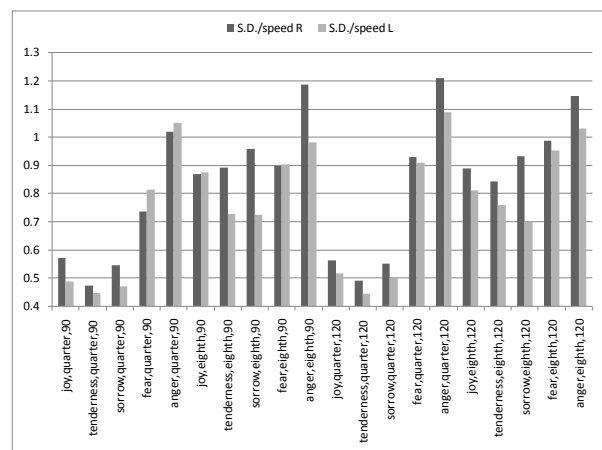**Figure 6**. The mean angle of each pattern

Figure 7. The mean of S.D./speed of each pattern

Tempo of the Speed, angle and S.D. were not different. At first explain is speed. A quarter note was faster than eighth note. The speed of joy was the fastest of all, and the speed of fear was the slowest of all. As the quarter note of the speed of tenderness was fast, but case of eighth note was slow.

The second explain is angle. The angle of quarter note was flater than eighth note. The angle of joy was the flatest of all, and the angle of fear was changed the largest of all.

For this reason, the speed and the angle were inversely proportional. In other words, the performance of more linearly hit is high speed, and the performance of angle change by slowing speed. Conversely, the performance was slowing speed for an angle change.

The third explain is S.D.. I thought that the reason of the difference of the S.D. pushes a stick to the drum. In other words, after a hitting, the distance of stick bounced back was short. The quarter note and eighth note were not different for the each emotion. The S.D. of anger was the highest of all, and the S.D. of tenderness was lowest of all.

Table 1. As the result of each element(speed, angle and S.D.)

	speed	angle	S.D.
joy	↑ ↑	↓ ↓	↓
tenderness	↑	↓	↓ ↓
sorrow	↓	↑	↓
fear	↓ ↓	↑ ↑	↑
anger	↑	↓	↑ ↑

The fourth explain is each emotion. The speed of Joy was fast, but the angle of the stick was flat. The distance of the stick bounced back was high. The high speed of tenderness performance was very difficult. So case of tempo up, speed was suddenly slowing down. In other words, this peform is like a staccato. The speed of sorrow was slightly slow, and an angle was slightly changed. But, from standard deviation, the performance was not pushes a stick, it raise a high with its rebound and bang down it from the position. In other words, this peform is like a staccato and *pp*. The speed of fear was slow, and the change of the angle was large. But it pushes a stick unlike the sorrow. The angle of anger was little change, and the speed was slightly fast. It was the strongest to pushes a stick.
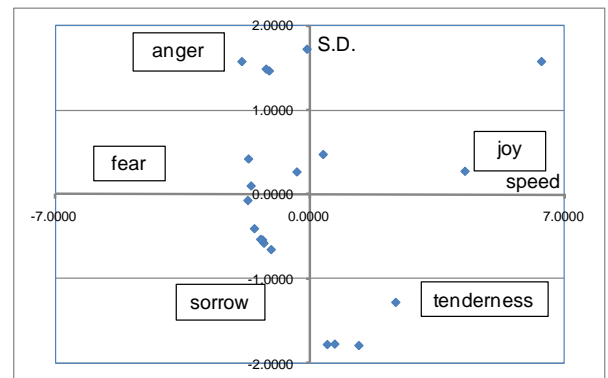
Principal component analysis

Next analisys was principal component analisis. Independent variable was mean data of speed, angle and S.D. (order of the contribution ratio). I chose three principal components from eigenvalue. Each principal component score showed the Table 2. And these principal component score showed to the scatter plot (Figure8 and Figure 9). Figure 8 showed principal component score that X axis is the speed and Y axis is the S.D.. Figure 9 showed principal component score that X axis is the angle and Y axis is the S.D..

This result showed influence of performance pattern in order of speed, S.D., angle. Figure 8 and Figure 9 showed similar layout of the Figure 1. I thought that correspondence relation of the motion for the five emotions was right, because it was got similar layout from principal component analysis. Also I think amateur performer will be easy to capture the sense by locating in the scatter diagram.

Table 2. As the result of principal component score

	speed	S.D.	angle
joy,quarter,120	6.3896	1.5804	0.6508
joy,quarter,90	4.2831	0.2773	−0.0268
tenderness,quarter,120	2.3769	−1.2790	−0.5168
tenderness,quarter,90	1.3619	−1.7916	−0.1564
sorrow,quarter,90	0.6990	−1.7747	0.0110
sorrow,quarter,120	0.4926	−1.7800	−0.2398
joy,eighth,120	0.3792	0.4770	−0.6084
anger,quarter,90	−0.0657	1.7271	−0.1982
joy,eighth,90	−0.3431	0.2695	−0.6334
fear,quarter,90	−1.0517	−0.6528	0.1938
anger,eighth,90	−1.1041	1.4689	−0.2501
anger,eighth,120	−1.1904	1.4909	−0.1359
tenderness,eighth,120	−1.2499	−0.5770	0.2643
tenderness,eighth,90	−1.2902	−0.5379	0.3366
sorrow,eighth,120	−1.3435	−0.5315	0.3395
sorrow,eighth,90	−1.5127	−0.4044	0.5354
fear,quarter,120	−1.6044	0.1034	0.1864
fear,eighth,120	−1.6746	0.4236	0.1543
fear,eighth,90	−1.6935	−0.0694	0.2255
anger,quarter,120	−1.8587	1.5801	−0.1319

Figure 8. The scatter plot of principal component score of the speed (X axis) and the S.D. (Y axis)
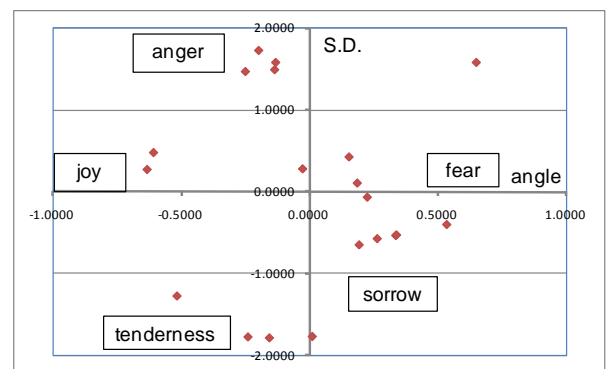
Figure 9. The scatter plot of principal component score of the angle (X axis) and the S.D. (Y axis)

CONCLUSION

In this study, an association between emotion and performance motion was clarified by analyzing the motion of the stick of a professional drummer in detail.

Using this result, I can make use for amateur training in future. This study was able to show easily understand form by visualizing the relations of emotion. Therefore I think that this study was significant.

As a future study, I consider whether the power of expression of emotion increases for the amateur by same motion of this result. Therefore I think that I make GUI to show to the performer definitely in the future.

REFERENCES

1 P.N. Juslin, "Communicating emotion in music performance: A review and theoretical framework.", Music and emotion., Oxford University Press., pp.309-337, 2001.

2 S. Ikoma, T. Yoshii and K. Inamura, "Emotional communication by improvisation with percussive timbre", Proceedings of the 22 th Congress of Japanese Cognitive Science Society, pp.202-203, 2005.

3 Yamasaki, T, "Emotional communication in improvised performance by musically untrained players.", Proceedings of the 17 th Congress of International Association of Empirical Aesthetics, pp.521-524, 2002.

4 Yamasaki, T, "Emotional communication through music performance by professional drummers", The human science research bulletin of Osaka Shoin Women's University, Vol.5, pp.111-122, 2006.

5 Y. Mito, H. Kawakami, M. Marumo, "Study of the impressions of tones during drum performance.", Proceedings of the 1 th Congress of Study Group on Psychology of Music, pp.26-29, 2009.

6 Y. Mito, H. Kawakami, M. Marumo, "Impression and motion of performance expression of the snare drum.", Proceedings of 2009 spring Congress of The Japanese Society for Music Perception and Cognition, pp.31-36, 2009.

7 H. Sato, T. Fujisawa, M. Miura, Y. Yuki, H. Kawakami, "Expressions of basic emotion on playing the snare drum", Proceedings of 2009 autumn Congress of The Japanese Society for Music Perception and Cognition, pp.45-50, 2009.