DOI: 10.61782/fa.2023.1235

forum acusticum 2023

ANALYSIS OF ROLL PERFORMANCE ON SNARE DRUM USING MOTION CAPTURE SYSTEM

Masanobu Miura
Department of Musicology and Music Informatics, Faculty of Music, Kunitachi College of Music, JAPAN

ABSTRACT

This paper introduces a recording experiment for snare drum roll performance using a motion capture system. The roll performance is known to be a tremolo to produce a continuous sound by hitting the drumhead with drumsticks. At here, the style of a concert snare drum is employed. The roll performance is realized by quick rebounds on drumsticks repeatedly, producing sounds like white noise. The author previously analyzed the roll performance using a high-speed camera, showing the trajectory of each snare drumstick and clarifying the overlap region of rebounds between left and right drumsticks. The author presented the recording result at Forum Acusticum in 2005. This paper provides an additional recording of it using a motion capture system. In particular, the author introduces a methodology to record the drumstick each on each using a motion capture system by embedding reflected markers on the drumstick to calculate the location of the tip on the drumsticks. According to the classification of roll performance by a percussion player, the roll performance is categorized into four, as a combination of directions and numbers of strokes.

Keywords: snare drum, motion capture, closed roll, performance analysis, digital musicology

1. INTRODUCTION

Snare drum playing is an essential part of orchestral or brass band performances of classical music. There are two types of snare drum rolls: open rolls and closed rolls. The former is played by alternately hitting the snare drum twice, while the closed rolls are left to the player, and the aspect of the closed rolls has not been clear. The author reported the recording results of them in 2005[1] and analyzed the the performance using a high-speed camera. Eighteen years have passed since then, and several studies to model and synthesize snare drum sound were conducted [2-3]. Other studies shows the difference of arm motion on the drums [4], and EMG recording when drumming[5-7]. At this time, the author analyzed the performance recordings by a motion capture system. In particular, the author reports the results of the investigation on the number of strokes.

2. RECORDING EXPERIMENT

2.1 Experimental Condition

Recording experiment for snare drum was conducted at Kunitachi College of Music (KCM). An optical motion capture system was used, where seven cameras are set in a room. The reflected marker on the tip of drumstick is not easy since it will occasionally be collapsed due to strokes by player. At here several markers are allocated on the middle of drumstick, as shown in Fig.1. Then the location of tip was estimated as calculating the relative distance from the markers on the middle. A marker on the bottom of drumstick is allocated but it is sometimes occluded in the hand of player, so the location of the bottom is also estimated from the markers.

Figure 1. Reflected markers on drumstick.

*Corresponding author: masanobu.miura@kunitachi.ac.jp

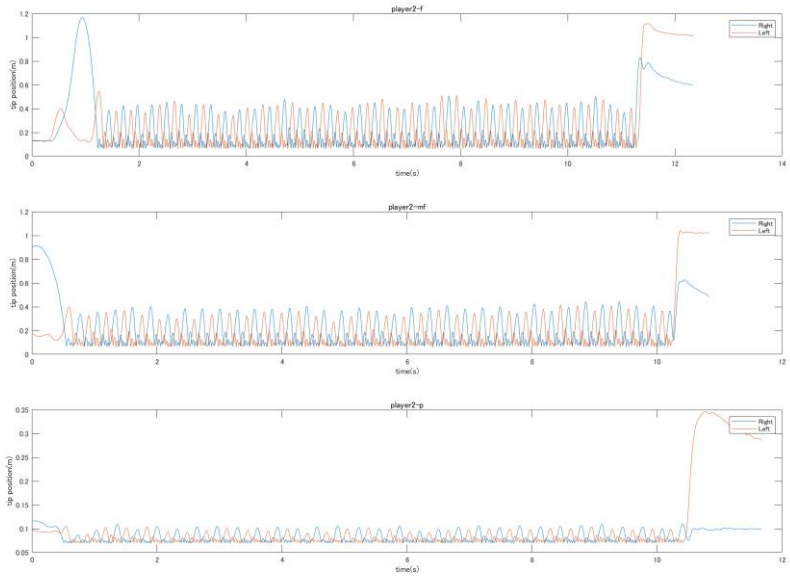

Figure 2. Example of recorded trajectory (player 2) of y-axis of the tip on drumstick.

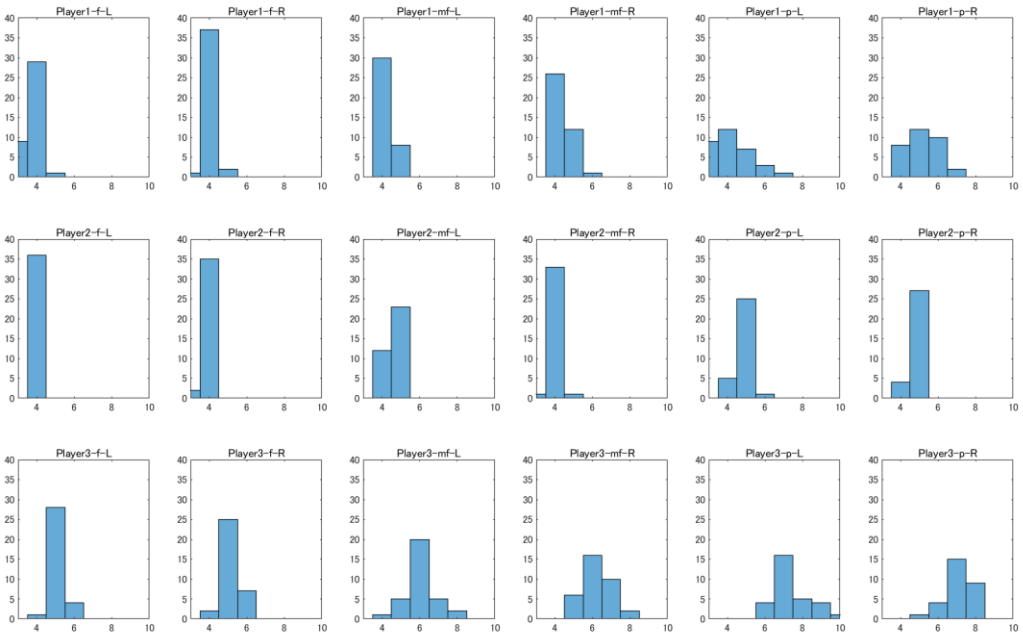

Figure 3. Histogram for the number of strokes (or bounces) on single arm motion.

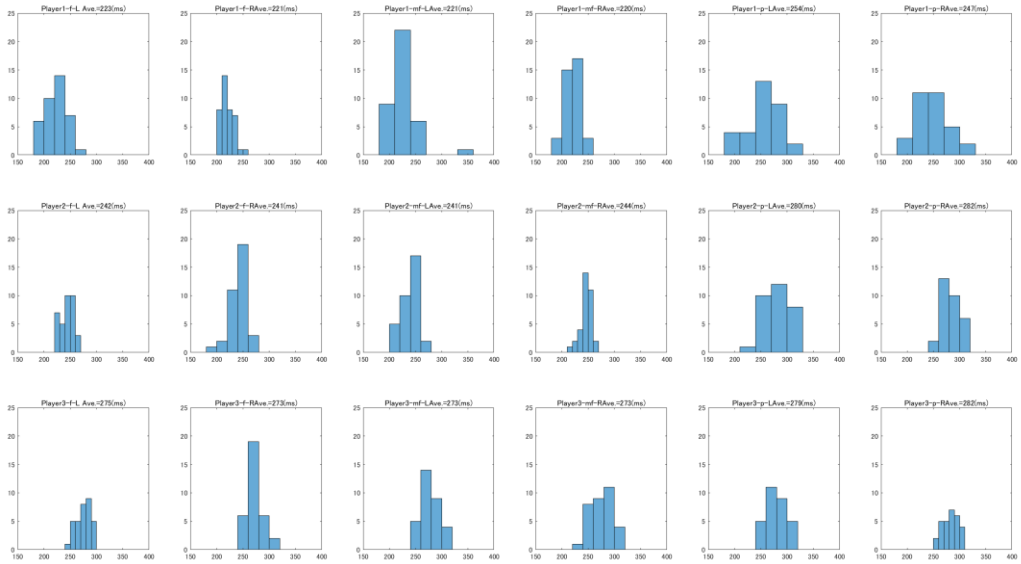

Figure 4. Histogram of intervals between the conjunctive 1st strokes.

2.2 Players and playing task

Three percussion players (player 1, 2, 3) participated in this test. The player 1 belongs to KCM as bachelor student majoring percussion instruments. The player 2 and 3 belong to Graduate school of KCM as PhD student majoring percussion instruments. In particular, the player 3's major background is marching band percussion instruments, whereas the players 1 and 2 are majoring classical style of percussion playing. The three players were asked to play closed roll for ten seconds. They were asked to play them in each of three dynamics patterns (such as forte, mezzo forte and piano) with five trials. After playing, the participants were asked to choose the best one by themselves, then only one trial for each dynamics condition is used on analysis.

2.3 Example of recording

An example of trajectory of tips of drumstick is shown in Fig.2. The trajectory is for the y-axis of the tips. The figure shows a typical result of the closed roll, in which strokes, or bounce clusters are alternatively repeated by left and right arms. Moreover, the change of dynamics is realized by the height of tips on the trajectory.

3. ANALYSIS AND DISCUSSION

3.1 Number of strokes in each stroke cluster

As can be seen in the trajectory of snare drum roll performance, several strokes on a single arm motion are observed. The number of strokes, or bounces, is the point of player's intension, then the number of strokes is thought as important. Here explores the histogram of the number of strokes is shown in Fig. 3. As can be seen in Fig.3, player's tendency is different among three players. For player 1 and 3, they tend to increase of strokes when playing in weak dynamics (*p*). In case of player 1, the number of strokes increases from four to five or six. For player 3, the number of strokes also increases from five to eight or up to nine. The player 2, however, does not show such tendency. He constantly produces four, or sometimes five in weak dynamics. The number of strokes in previous report [1] shows three, four or sometimes five in each cluster, but all of them were conducted under intermediate dynamics (mezzo forte).

3.2 Interval of conjunctive 1st stroke

The interval of conjunctive 1st strokes, which means the interval between left and right hand, is measured and listed in Fig. 4. Also, the averages of intervals are labelled on the

tile of each panel. The result of the interval shows different tendencies among players. For player 1, the average interval becomes longer by the change of dynamics from loud to quiet playing. For player 2, he also provides longer intervals by the change of dynamics from loud to quiet. On the other hand, the player 3 does not show such change. Compared to the previous report [1], the interval ranges from 250msec to 350msec by professional players, and 200 msec for amateur player.

4. DISCUSSION

From the result of Figs 3 and 4, the change of dynamics is realized in both number of strokes and change of length on intervals. In player 1, he changes the interval longer and increases the number of strokes to realize quiet closed roll. The player 2 realizes the quiet closed roll by the change of length of intervals only. He never changed the number of strokes. On the player 3, he never changes the length of intervals but changes the number of strokes to realize quiet closed roll. As a whole, on the snare drum playing, players tend to change then length of intervals on 1st strokes, and/or the number of strokes in a single arm motion.

5. CONCLUSION

At here the author introduces the change of dynamics on closed roll may be realized by the change of length of intervals on 1st stroke, and/or, the number of strokes in a stroke cluster. The findings were not pointed out in my previous report [1], so it could become the guideline of acquiring the skill of closed roll by novice players.

6. ACKNOWLEDGMENTS

The author greatly acknowledges Mr. Kazuhide Takeshita, who helped the author to conduct recording experiment and give the author advice from the viewpoint of percussion playing. This study is supported by Research Fund on Kunicathi College of Music.

7. REFERENCES

[1] Miura, M. (2005). Inter-player variability of a roll performance on a snare-drum performance. In Proc. Forum Acusticum, Budapest, Hungary (Vol. 2005, pp. 563-568).

[2] Gillick, J., et al. (2021). Drumroll Please: Modeling Multi-Scale Rhythmic Gestures with Flexible Grids. Transactions of the International Society for Music Information Retrieval, 4(1), pp. 156–166. DOI: https://doi.org/10.5334/tismir.98

[3] Robin Gray, Simon Lindsell, Rachael Minster, Ian M. Symonds, Kia Ng. (2009). An Augmented Snare Drum. Proc. of the 2009 International Computer Music Conference, ICMC 2009, Montreal, Quebec, Canada, August 16-21.

[4] Sofia Dahl (2000). The Playing of an Accent – Preliminary Observations from Temporal and Kinematic Analysis of Percussionists, Journal of New Music Research, 29:3, 225-233, DOI: 10.1076/jnmr.29.3.225.3090

[5] Fujisawa, T., and Miura, M. (2010). Investigating a playing strategy for drumming using surface electromyograms, Acoustical Science and Technology, 31, 4, pp. 300-303. https://doi.org/10.1250/ast.31.300,

[6] Miura, M. (2012). Playability of electric snare drum based on the rebound feature, Acoustical Science and Technology, 33, 3, pp. 170-179. https://doi.org/10.1250/ast.33.170,

[7] Fujii, S., and Moritani, T. (2012). Rise rate and timing variability of surface electromyographic activity during rhythmic drumming movements in the world's fastest drummer, Journal of Electromyography and Kinesiology, 22, 1, pp. 60-66.