ForumAcusticum
2 0 0 5

Inter-Player Variability of a Roll Performance on a Snare-Drum Performance

Masanobu Miura
Dept.of Media Informatics, Fac. of Sci. and Tech., Ryukoku Univ., 1-5, Seta, Oe-cho, Otsu, Shiga, Japan, **miura@rins.ryukoku.ac.jp**

This study investigates characteristics of a stick motion on playing a roll-performance on a snare-drum, using a high-speed camera. Tremolos or trills on percussion instruments are called "roll-performance", in which tones are played iteratively and rapidly. Two types of roll-performance, open and closed, are mainly used in snare-drum performance on various kinds of musical styles, such as orchestra and/or marching concerts. On practicing open roll-performance, beginners are usually instructed to produce two strokes on each hand rapidly and alternatively, such as RR LL RR LL. In case of closed roll-performance, beginners are usually instructed to produce more than three strokes for each hand. Beginners, however, sometimes feel difficulties in realizing closed roll-performances, because no more instructions are usually given to them, though it is easy for professionals to produce closed roll-performance. To clarify the characteristics of closed roll-performance by professional percussionists, employed here is a high-speed camera and a motion capture system. Three professional percussionists were asked to perform closed roll-performance with a constant sound level (mezzo-forte, in this test). Tracks of performers' sticks were extracted from the recorded pictures at a rate of 1kHz. You can see that an arm motion produce a couple of strokes, named "stroke cluster". It is found that professional percussionists can control the first strokes of stroke clusters more precisely than amateurs. Models for a system producing closed roll-performances are discussed in this paper.

1 Introduction

Musical performance using musical instruments, such as a piano and/or a violin, often realize various kinds of aesthetics. Performances produced by professional players have been analyzed to clarify what features contribute to such nice performances. By analyzing the relationship between physical features of nice performances and subjective impression for them, a system of “Musical communication” in which players and listeners enjoy music will be clarified and thus you will understand how you can enjoy music and how performers inform aesthetics of music to listeners,.

Investigated here is roll-performance that is usually employed in orchestra percussion performance. A few researches have been trying to analyze mechanism of arm motions of playing drums[1], introduced here is a measurement result of roll-performance. Performances by three professional percussion players are recorded and variability of drum stick movements among players is discussed.

2 An outline of Roll-performance

2.1 Roll-performance in general

“Roll-performance”, or simply “roll” which is commonly used expression, means tremolo or trill on various kinds of percussion instruments such as snare-drum, timpani, marimba, and so forth[2,3]. For realizing roll-performance players have to repeat playing single note or notes rapidly, so that it sounds like a single long tone. Using this technique, players can produce long tones even if they play percussion instruments having rapidly decreasing tones. On playing timpani and marimba, players usually employ “single stroke roll-performances”, in which the number of stroke is identical to arm movements, such as LRLR... On playing snare-drums, player usually employ “double or triple stroke roll-performance”, in which the number of strokes are twice or three times of arm motion, such as LLRR.. or LLLRRR... .Other roll-performance, such as more than triple strokes, is often employed on snare drum.

2.2 Grips and finger movements at performing roll

2.2.1 Traditional grip and Matched grip

Several kinds of grips are employed on playing percussion instruments using drum sticks. Two kinds of gripping style, “traditional grip” and “matched grip”, are commonly used on percussion playing. Figure 1 shows examples of gripping drum sticks. In Fig.1 (a), the traditional grip is shown, having different grips among hands. From historical viewpoints, snare drum were usually employed in military marching, and snare drums were located in front of players suspended from a player’s shoulder, so surface of snare drum, called “drumhead”, should be tilted. It is thought that the regular gip was developed to deal with the tilted surface. Figure 1(b) shows another type of gripping, called “matched grip”, in which each hand holds sticks in the same way. Matched grip is usually employed in playing snare drum, timpani, marimba, and so forth.

Three styles of matched grips are well known, “American”, “German”, and “French” style. One of the main differences among them is the angle of palm. As shown in Fig.1(b) the palm of hands are almost parallel to the horizontal plane, whereas they have 90-degree to it at French style. American style allows players’ palms having 45-degree to it. Players usually select the grips at their own taste and characteristics of playing percussion instruments. For example, on playing timpani, each of styles is often employed, but on playing snare drums the French style is rarely employed.

It is assumed in this study that players take choose a grip of his/her performance the matched grip of American or German style, which are orthodox styles at performing orchestra style. Other types of grip, matched grip, French style, and the “traditional grip” are not employed on this paper.

2.2.2 Finger movement at performing roll

It is possible to image that players realize double or triple stroke roll-performances by means of free bounding of drum sticks after the first stroke, by changing the force of gripping drum sticks using thumb and index finger so that drum stick motions would well move as they want. Other three fingers, middle, ring and little fingers, sometimes control the bouncing drum sticks. Figure 2(a) shows a side view of gripping drum stick on matched grip. Figure 2(b) shows the fulcrum point of the drum stick held by thumb and the index finger.

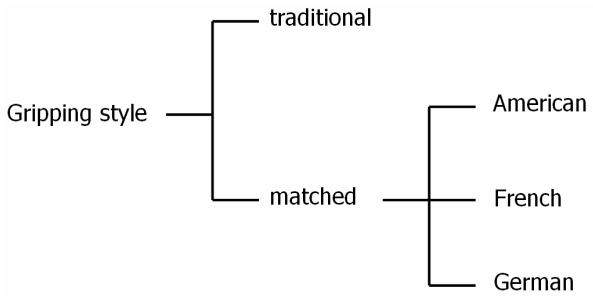
Variations of roll-performance realized by numerous kinds of percussion instruments such as tambourine, castanet, and so forth, are not treated in this paper.

2.3 Roll-performance on snare-drums

Two kinds of roll-performance on snare-drum are commonly used; “open roll” and “closed roll”. On performing open roll, players should produce just two strokes by controlling the bouncing drum stick after stroking the first stroke. Figure 3(a) shows its musical score and an example of real performance corresponding to it. As you can see in Fig.3 (a), just two strokes are produced alternately among left and right hands. On playing closed rolls, players usually produce more than three strokes on each hand movement and strokes by overlapping strokes among hands. Figure 3 (b) shows its musical score and an example of real performance as an estimated pattern. Beginners have no idea for producing closed roll-performance, because just simple and ambiguous instructions are given to them, such as “do like what teachers do”. This is kind of a barrier for beginners to practice closed roll-performance.

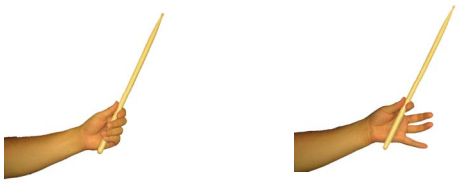
(a) An example of the “traditional grip”

(b) An example of the “matched grip of German style”



(c) Classification of gripping drum sticks

Fig.1 Example and classification of gripping drum sticks.

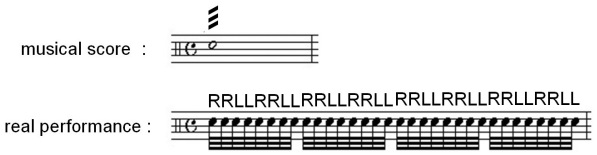


(a)using all fingers (b)using thumb and the index finger

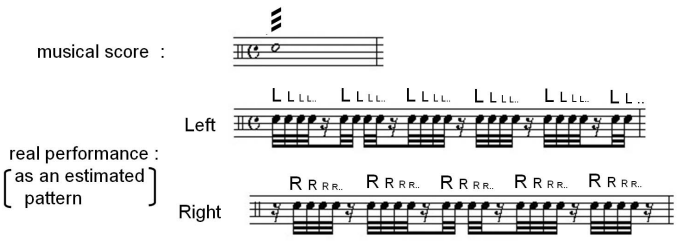
Fig.2 Gripping of a drum stick.

2.4 Classification of roll-performances

Figure 4 illustrates types of roll-performances using some percussion instruments. Most of roll-performances are produced by "single stroke roll", so variability among players is not so much, just presented in sound pressure levels of each stroke and time interval among strokes. Variability of open roll-performance among players is also presented in them. However, variability of closed roll is thought to be presented in other complex features. So, it is desired to clarify what features of closed roll is important and reflects the skill of players.



(a) Examples of musical score and its real performance of the open roll.



(b) Example of musical score and its estimated performance of the closed roll.

Fig.3 Examples of musical scores denoting (a) open and (b) closed roll performances.

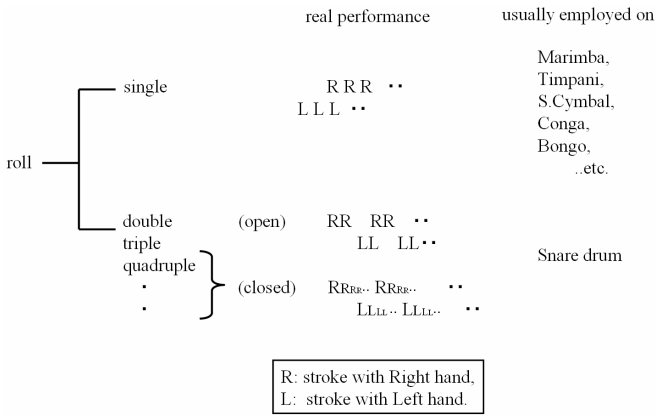


Fig.4 Types of roll used in percussion performances.

3 Recording experiment

3.1 Outline of the experiment

Closed roll-performance by three professional percussionists are recorded by a high-speed camera and analyzed to clarify the details of drum stick motion on closed roll-performance.

Subjects: three professional percussionists (P1-P3), who had been majoring in percussion performance at musical college more than four years. All of them are female and mainly play percussion instruments on orchestra styles, rarely play military marching drums. P1 usually plays marimba and snare-drum, P2 mainly plays snare-drums, and P3 plays many kinds of percussion instruments, P3 is the youngest player and has the least experiences of performances among subjects.

Task: to play closed roll-performances within ten seconds, keeping almost equal loudness as possible. Instructed level is *mf* (mezzo-forte). Performances are recorded four times. Players are required to wear a white jacket, so as to cut colors of players' wears.

Drum stick: Playwood M-15C (made by maple wood). Tips of drum sticks are colored with blue for left hand and red for right hand. Stick bodies except tips are colored to white, so as to extract tip motions easily by a motion capture system.

Snare-drum: Sonic Plus II (SONOR Inc.).

Grip: Matched grip as German or American style. Players are allowed to choose which they want to.

Camera: "Motion Pro", by NIPPON-Roper Co.Ltd. Employed recording rate is 1000fps, and the shutter speed is 1/4000 sec.

Motion Analysis software: "DIPP-Motion", by DITECT Co. Ltd.

3.2 Recording environment

Figure 5 shows the environment of the recording experiment. High-speed camera is set in front of players, and performance sounds are recorded via microphone. Lights providing strong brightness are set above players for lighting the movements of drum stick. Players are instructed to wear a sunglass for safe of their eyes.

3.3 Recording scheme

Firstly subjects are allowed to play freely the given snare-drum. After they finish free-playing, recording experiment starts. Giving a start cue produced by an instructor, players are instructed to start playing closed roll-performance about 10 seconds long. After stopping recording pictures and sounds, recorded pictures are analyzed to extract tip tracks from them.

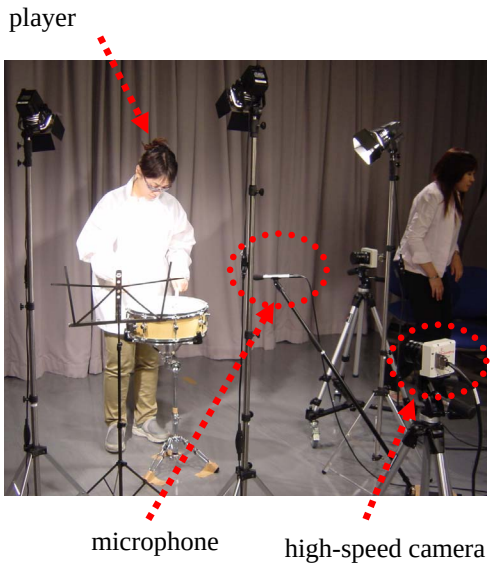


Fig.5 Recording environment.

3.4 Extracting tip movements using a motion capture system

Tip motions are extracted using a commercial sold system of a motion capture. Motion pictures are converted to monochromatic pictures. For tips of the drum stick are colored, it is easy to search the tip tracks between pictures automatically, by comparing successive two pictures. At this study the center of tips are target for searching tip motions. Correlation between two pictures is the technique for searching the center of tips.

4 Results and Discussion

Figure 6 shows traces of tip on playing closed roll-performance for each subject. Ordinate represents height from the drumhead and abscissa also represents distance of tip motions. As you can see in Fig. 6, tip tracks depend on players even if they are all professional players. Figure 7 shows tip tracks for each drum stick of the second trial of P2, in which ordinate represents height from the drumhead, and abscissa represents time (msec). In Fig.7 you can see some sequence of strokes, named here is a “stroke cluster”. Players are thought to be able to control the following features: (a) the onset time of each stroke cluster, and (b) number of strokes included in each stroke cluster. Following section will discuss controlability of features on professional players.

4.1 Onset times of each stroke cluster

Inter-onset-intervals of the first stroke included in stroke clusters for all subjects are shown in Fig.8, ordinate represents IOI of the first stroke of the included stroke cluster and abscissa represents subjects including a result of an amateur percussion player [4]. As you can see in the figure, while average time of IOI among professional players are not common, deviation of the first stroke included in stroke clusters for professional percussionists are smaller than those of amateur’s. This fact implies that professional percussionists can control precisely the first stroke included in stroke clusters compared with an amateur player.

4.2 Number of strokes included in each stroke cluster

Number of stokes for all professional subjects are shown in Table 1. As shown in Table 1, number of strokes is not common among subjects. Although number of strokes have variation between three to six, in this test three or four strokes on each stroke cluster is an orthodox style on closed roll-performance. Remarkably, the number of strokes is not important for realizing closed roll, whereas instructions of closed roll are concentrated to the number of strokes.

5 Conclusion

In this study closed roll-performance are recorded by high-speed camera and tip motions are extracted from recorded pictures using a motion capture system. As a

result, there is a variation for number of strokes among subjects, whereas deviations of IOI of the first stroke included in stroke clusters are smaller than those of amateurs. Future research is to develop a measurement method for instant pressure of tips against surfaces of snare-drum, to analyze variations of horizontal movements among players, to correspond between cognitive features of roll-performance and physical features of it, and to analyze control features between right and left hands.

Acknowledgements

This study has been partly supported by Grant-in-Aid for Scientific Research (No. 16700154), MEXT, by High-tech Research Center promoted by Ryukoku University, and by Ryukoku University Science and Technology fund. The author expresses sincere thanks to Ms. Tamaki Kitamura, bachelor student of Ryukoku University, for her help in recording and analyzing closed roll-performances, and Ms. Tomoe Nakaji, professional percussionists, for her help in giving suggestions and ideas for this study.

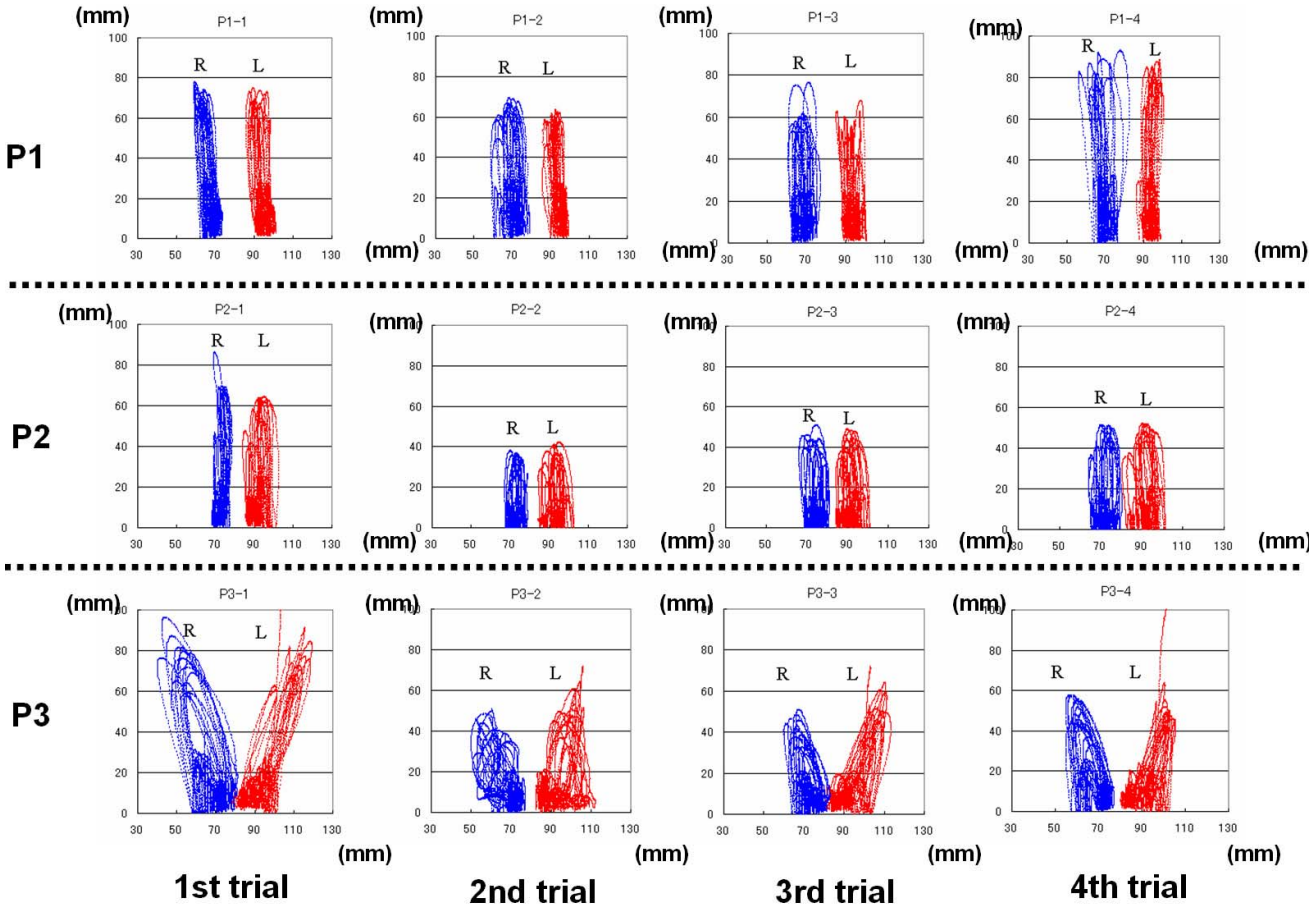


Fig.6 Tracks of drum stick tips on playing closed roll-performance.

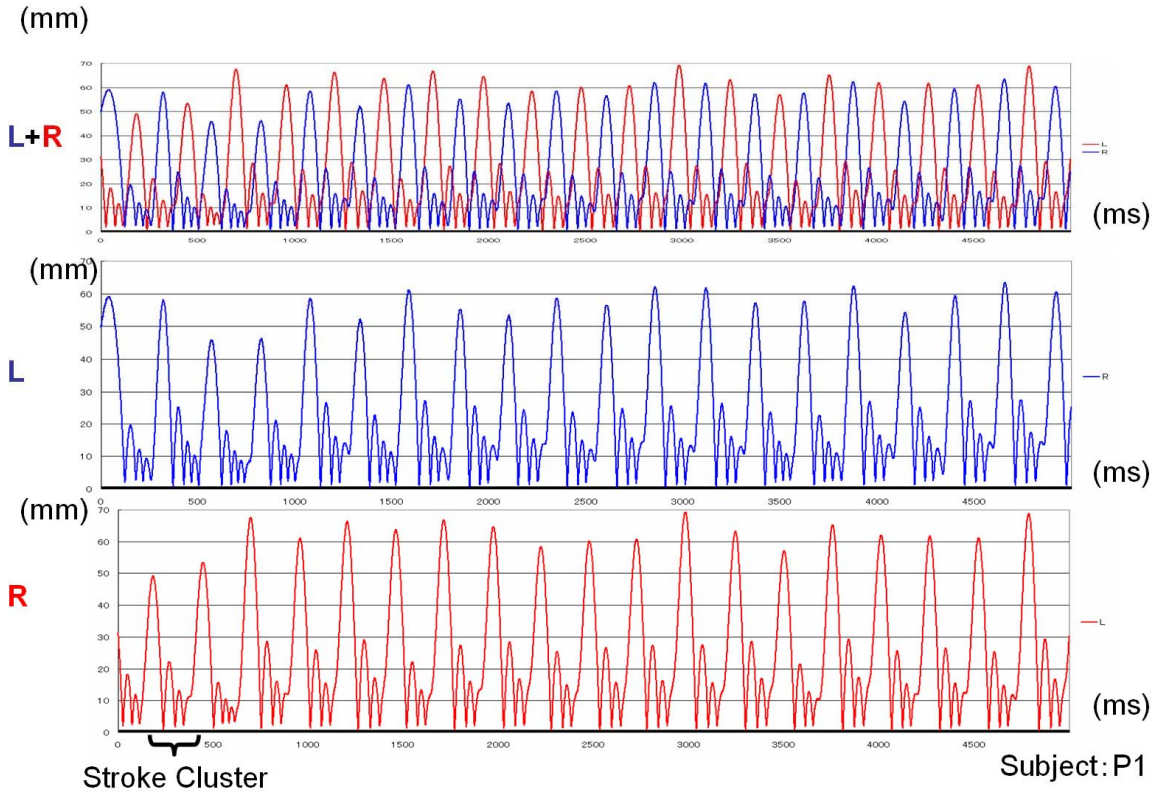


Fig.7 Tracks of drum stick tips on the second trial of P1 in Fig.6.

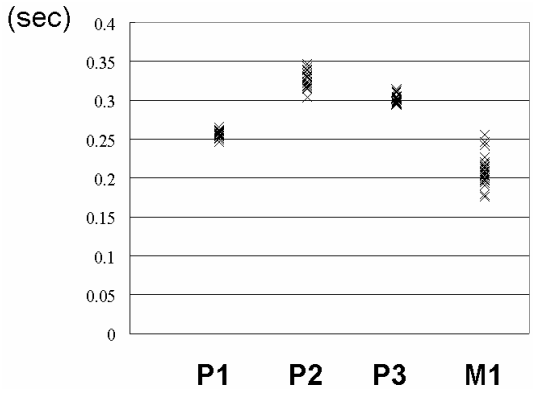


Fig.8 IOI of the first stroke for each subjects including amateur player [4].

Table 1 Comparison of average rate for number of strokes included in a stroke cluster among professional players

	P1(L)	P1(R)	P2(L)	P2(R)	P3(L)	P3(R)
2	0.014					
3	0.878	0.260	0.049	0.049	0.032	0.484
4	0.108	0.740	0.885	0.885	0.710	0.516
5			0.066	0.066	0.242	
6					0.016	

L: Left hand, R: Right hand.

References

[1] S. Dahl, 'Arm Motion and Striking Force in Drumming', *Proc. of Int, Symp, on Musical Acoustics 2001*, pp.293-296 (2001).

[2] N.Slonimsky, 'Dictionary of Music', Macmillan (1998).

[3] H. C. Okubo, 'Basic Rhythm Method for Snare Drum', ATN (2003, in Japanese)

[4] M. Miura and T.Kitamura, 'Inter-Player Variability of Time-Control Mechanism on the Roll-Performance Using a Snare Drum', *Proc. of Semi-annual Meeting for Acoustic Society of Japan*, pp.683-684 (2004, in Japanese).