A SUPPORT SYSTEM FOR BASIC PRACTICE OF PLAYING THE DRUMS

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ABSTRACT

We proposed and developed a computer system that can be used to help drummers to practise a technique called here ‘drum-loop performance’ (DLP)” using a MIDI drums. We define DLP as repeatedly playing basic rhythm patterns that consist of one or two measures under given tempi. Training in this way as much as possible is a highly effective way for drummers to develop their basic skills. Our research covers three key areas. First, we have investigated what kind of features of a player’s performance should be used to evaluate their proficiency. Second, we have decided on criteria for evaluating performance proficiency, and, third, we have developed ways of visually representing the relevant information to the player. Moreover, on the basis of the developed way, we constructed a support system which can be used to visualize the player's performance situations in real-time. Using the system, a player visually reviews his/her performances while playing. Therefore, a player should be able to immediately recognize performance errors, and be aware of his/her tendencies and weak points much more easily than by merely listening his/her performance.

1. INTRODUCTION

The drum kit is a set of percussion instruments, which is often used in various kinds of popular music, such as rock, jazz and so forth. Beginners sometimes learn to play the drum kit in their own way without any advice from instructors. However, if a beginner teaches him/herself, getting objective evaluations of his/her performances is difficult. Therefore, we need to find a way to assist such beginners in confirming the accuracy of their performance and/or evaluating how well they are playing.

Though many support systems for practising various musical instruments have been reported [1-3], there have been few such support systems for learning to play the drum kit. We propose the use of a support system that is aimed at a specific way of training a beginner to play the drum kit.

2. TARGET PRACTICE STYLE: DRUM-LOOP PERFORMANCE (DLP)

One of the most basic ways practising the drum kit is called here drum-loop performance (DLP): drummers repeat basic rhythm patterns, as shown in Fig. 1, which consist of one or two measures under a given tempo. In Fig. 1 are two typical patterns of rhythms, an eighth-note one and a sixteenth-note one. By practising DLP, a drummer should learn to coordinate his/her arms and legs in the prescribed order, and to hit the drum kit with aimed timings and intensities. The drummer should also learn how to keep his/her individual tempo constant during playing. Therefore, we focused on enabling learners to practise using DLP.

![Figure 1. Examples of rhythm patterns employed in DLP](image)

3. OVERVIEW OF PROPOSED SYSTEM FOR PRACTISING THE DRUM KIT

An overview of a proposed system for practising the drum kit is described in Fig. 2. A drummer inputs or selects a musical score, which he/she wants to practise, and plays the score using a MIDI drums and while listening to a metronome. The performance is recorded as MIDI data and then analyzed by the proposed system. The feedback is given to the drummer as representations of his/her performance in real-time. When the drummer has finished playing, the proficiency of the entire performance is automatically evaluated. Moreover, the system predicts the drummer’s weak-points using the evaluation results of both the current and the previous performances, and gives appropriate instructions, advices, and information to the drummer by using visual and/or auditory feedback. The drummer continues his/her practice whilst responding to the information given from the system.

The key processes used in the proposed system are as follows: analyzing input performances, evaluating the performance proficiency, data mining, and predicting the player’s weak-points. The purpose of analyzing input performances, shown in Fig. 2, is to recognize in real-time whether or not what has been played really follows the given score. The system matches the input performances with the playing score, and therefore detects, at each point in the score any errors made by the player. Such errors include missing notes, onset
We have made an algorithm that can be used for matching an input performance on the drum kit with the score [4]. During the next process, evaluating the performance proficiency, the system automatically evaluates how well the drummer has played the score. The criteria for evaluating his/her performance have been constructed on the basis of the results of a survey completed by trained drummers (see Section 6). During the data mining process the system makes a portfolio of the player on the basis of the results of past evaluations. These results can be useful for getting player’s performance tendencies over a long period. During the next stage, predicting player’s weak-points, the system predicts the likely reasons for a player being unable to play the score well. It does this by referring to past results of evaluations, and gives appropriate advices and/or instructions to the player. To make such a prediction, we need to gather several instances of player errors combined with the corresponding patterns of advices and/or instructions.

The process of the matching is briefly explained as follows: a performance note can be matched with a score note that has a relatively small onset deviation from it. If several performance notes can be matched with a score note, the performance note having the largest intensity is chosen as the corresponding note to the score note. The other performance notes are treated as insertions. Score notes that do not match any performance note are treated as missing notes.

As drum performances often include a lot of inserted notes that are performed softly, the proposed method is a simple and reasonable way of matching performance and score. Furthermore, in practice, such inserted notes are not necessarily performance errors. An example of inserted notes is called “ghost-note”, which is a kind of performance note not usually described in musical score, but one improvised by the drummer. The ghost-note is usually played very softly. A ghost-note can be written in parentheses, as shown in Fig. 4.

Several amateur drummers were asked to perform several types of musical score, and their performances were analyzed. A result of a beginner who has been playing for six months is shown in Fig. 5, and Fig. 6 shows a result of an intermediate drummer with seven years of experience. They played the given score shown in Fig. 1 (a) at a tempo of 100 bpm. Here, the horizontal axis represents the onset time on the score, and the vertical axis represents the onset deviations from references such as the click of a metronome at each onset time on the score. The values on the vertical axis indicate deviation from the click of a metronome; a
positive value indicates that the player was behind and a negative one means he/she was ahead. The hi-hat cymbals, snare drum, and bass drum are represented by HH, SD, and BD, respectively. The moving average (MA) of onset deviations of all percussion instruments is indicated by the dark line. A value in MA is calculated as the average of onset deviations included within the span of a quarter note before or after a certain onset time on the score.

We see here that there are some correlations between the onset deviations among the different instruments, and believe that they are caused by fluctuations of the player’s individual tempo. As it was confirmed that the tendencies are common to the all drummers, we can assume that the overall shape of the MA curve represents a player’s individual tempo.

These results suggest that onset deviations from the metronome were generated at least by two factors: the fluctuation of the player’s individual tempo and onset deviations from the MA curve.

![Figure 5. Performance results of a beginner](image)

**Figure 5. Performance results of a beginner**

![Figure 6. Performance results of an intermediate drummer](image)

**Figure 6. Performance results of an intermediate drummer**

6. SCHEME FOR EVALUATING PERFORMANCE PROFICIENCIES

The use of a scheme that is suitable for evaluating performance proficiencies and which analyzes the results of several DLPs is proposed here. Its outline is shown in Fig. 7. The proficiencies of the entire performance are systematically evaluated in order to evaluate missing notes, onset deviations, and intensities. A player’s evaluation results, which step the player has passed, over time are gathered together and thus form a comprehensive history of his/her progress.

![Figure 7. Scheme for evaluating performance proficiencies](image)

**Figure 7. Scheme for evaluating performance proficiencies**

7. FEEDBACK FROM THE SYSTEM

The proposed system depicts occurrences of missing notes, onset deviations, and intensities as a representation of an instantaneous evaluation of performance. It also draws a curve of the moving averages for onset deviations, on the assumption that it was a temporal tendency of the individual’s tempo fluctuations. Furthermore, the system graphically shows statistical values at each note included in the musical score. They, for instance, include the average onset-deviation and the average intensity of each note.

The user is able to refer to such visual information when the system gives him/her advice appropriate for his/her proficiency. The user confirms it, and improves his/her performance appropriately. Moreover, the system gives instructions to the user. A number of manuals for playing the drum kit, for example [6], typically give the following instructions to players who are struggling to play a given score: attempt to correctly play just a part of the score, such as the part played with the hands or with the legs, play the score at a slow/relaxed tempo, gradually increase the performance tempo until he/she can reach the desired tempo, play the drum kit in time with a metronome, i.e., the DLP. Such instructions are thought to be effective ways for helping a player to learn a new rhythm. Therefore, we are going to incorporate these helpful instructions into our system.

8. IMPLEMENTATION

We have developed a sub-system of the proposed system. We can use the current system to match performance notes inputted from a MIDI drums with notes included in a given score, and to visualize in real-time the instantaneous evaluation of performance, which represents occurrences of missing notes, onset deviations, and MIDI-velocities. A player should be able to visually review his/her performance situations...
during playing, and immediately modify his/her performance.

A screen capture of the current system is shown in Fig. 8. As shown in Fig. 8 (a), the user inputs the rhythm pattern, tempo, and number of loops. The user clicks the [Start] button to make the metronome click and a model performance is then played by a computer MIDI synthesizer while the player plays along on the MIDI drums. If desired, he/she can stop the practice at any time.

During the performance, the system records the user’s performance, and after finishing the performance, it outputs the performance data for each instrument as CSV files. Instantaneous evaluations of performance are represented, as shown in Fig. 8 (b).

9. CONCLUSION AND FUTURE WORK

The current system is able to visualize only instantaneous evaluations of performance. These evaluations comprise of missing notes, onset deviations, and MIDI-velocities. Our future research plans are to develop a fuller system that can be used to evaluate performance deficiencies on the basis of our scheme, and to give more finely-tuned information, advices, and instructions to each player, and also to develop concrete methods for data mining and for estimating a player’s weak points.

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11. REFERENCES


