A Virtual Violin System Based on Gesture Capture using EMG and Position Sensors

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ABSTRACT

We apply sensor technology to the automatic detection and analysis of gestures during music performances. Taking the violin as a case study, we measure both right hand (i.e. bow) and left hand (i.e. fingering) gestures in violin performances. Based on these data, we create the first model of an interactive music instrument as a virtual violin that gives musical feedback of gestural performance to novice users, by giving sound output directly mapped from motion data, as well learning from user gestures to adapt the sound manipulation.

Author Keywords

NIME, Electromyogram, Max/MSP, Machine Learning

ACM Classification

H.5.2 [Auditory (non-speech) feedback] User Interfaces H.5.5 [Information Interfaces and Presentation] Sound and Music Computing.

1.INTRODUCTION

Learning to play a musical instrument is a complex task which is mostly based on the master- apprentice model in which modern technologies are rarely used. While motion capture technologies have been widely used for instance in sports science, detecting musical gestures has been much less explored. The automatic detection and analysis of such gestures would be of great use for enhancing music instrument learning.

The aim of this work is to apply sensor technology to the automatic detection and analysis of gestures during music performances. Taking the violin as a case study, we measure both right hand (i.e. bow) and left hand (i.e. fingering) gestures in violin performances. Our aim is to detect bow velocity and fingering by using of-the-shelf EMG and motion capture (e.g. Myo and Riot) sensors positioned in the forearms of the musician [1].

2.METHOD

Using EMG and motion capture sensors we track motion of both right and left forearms, as well electromyogram data of the left forearm in order to detect finger movements. Based on these data, we create the first model of an interactive music instrument as a virtual violin that gives musical feedback of gestural performance to novice users, by giving sound output directly mapped from motion data, as well learning from user gestures to adapt the sound manipulation. It is known that little differences on gestures may produce big differences in performed sound [2]. Therefore, this interactive model can be applied as an ecological validation model on learning and performing musical instruments, giving acoustic feedback to the users on how they are performing. The system is implemented in Max/MSP and Wekinator [3] which is a java framework for artists to implement machine learning models using data signals. We use two Myo sensors, each one composed of 3DoF Gyroscope, 3DoF Accelerometer, 4DoF orientation quaternion, 3DoF Euler-Angular position, and 8 electromyograms. We use as well one Riot sensor for the right hand, which has 3DoF Accelerometer, 3DoF Gyroscope, 3DoF Magnetometer and a Myogram sensor developed by Bitalino to track tendon activity from the left wrist.

3.RESULTS

The preliminary results show that it is possible to fine-tune a machine learning model to track the left-hand fingers. First, it is modelled as part of an interactive instrument for novice music students but the aim is to apply an optimised model into a computer self-learning assistant that will give feedback on how to enhance gestural and postural performance on the violin.

4.CONCLUSIONS

This system constitutes the first step to develop a computer-based motion self-learning assistant. Tracking both left and right-hand muscular activity gives insights on how performers are executing fine gestural movements as well as the amount of force being applied on specific technical interpretations. Having precise models of good practices may provide useful real-time feedback to learners on their deviation from a target performance.

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