IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321-5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 7, Issue 2, February 2019

Motion Analysis of Volleyball Sport

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Abstract: Sports skill discrimination using motion picture data, focused on volleyball attack skill is performed. We attempt to certify the hypothesis that expert skills have relatively low frequency motions rather than novice skills as the similarity of human postural control. We carry out experiments and analyze sports skills as for frequency of motion using time series motion pictures of volleyball attacks. The volleyball play is analyzed with motion picture data recorded by hi-speed cam-coder, where we do not use physical information such as body skeleton model, and so on. From motion picture data Time series data are obtained with four marking points, and analyzed using Fast Fourier Transform (FFT) and clustering data mining method. As the experiment results, we have found that y-axes of novice data have more high-frequency data, and that implies novice motions have high frequency motions, and that may support our hypothesis.

Keywords: Motion picture data, high speed camcorder, Fast Fourier Transform (FFT), Clustering

I. INTRODUCTION

Motion Analysis of Volleyball Sport is a image processing project that do sports skill discrimination using motion picture data, focused on volleyball attack skill. Volleyball play is analyzed with motion picture data recorded by hi-speed cam-coder, where we do not use physical information such as body skeleton model, and so on. From the motion picture data time series data are obtained with four marking points, and analyzed using Fast Fourier Transform (FFT) and clustering data mining method.

Sport technique evaluation using motion analysis model by neural networks and data mining methods is done. Some technique rules classified member of table tennis club, middle level player and beginner as fuzzy rules, and also estimated the movement of the marking points to improve in table tennis technique has been obtained. In Introduction, the human skill research for movement, the technique skill consists of hierarchical structure with a mono-functional layer to generate the single function result and a meta layer that adapted itself to an environmental change. Sport technique evaluation using motion analysis model by neural networks and data mining methods is discussed. At first selection of total 15 subjects of university students who are seven expert players of the table tennis club, three middle players experienced table tennis, and five beginners was done and recorded a trajectory pattern of forehand stroke for batting a ball with their the handshake-grip racket by a high-speed camera. Methodology used in internal model was identified by TAM network, C4.5, Native Bayes Tree, and Random Forest, and discussed the relationship between the mono-functional layer and the Meta layer in the internal model. Finally, we obtained some technique rules as fuzzy rules, and estimated the movement of the marking points to improve in table tennis technique. The main advantage is evaluation of technique skill of a forehand stroke of table tennis with three classes, and identified the internal model of a technique skill with TAM network was done. In addition, the mono-functional skill and the meta skill to improve technique of table tennis is discussed [1].
A time series data analysis for sport skill using data mining methods from motion pictures, focused on table tennis is presented. Use of high speed motion pictures, from which time series data are obtained and analyzed using data mining methods such as C4.5 and so on is done. Identification of internal models for technical skills as evaluation skillfulness for forehand stroke of table tennis, and discussion of mono and meta-functional skills for improving skills is performed. It assumes that technical skills consist of internal models of layered structure as, Mono-functional skills corresponding to each body part, and Meta-functional skills as upper layer. As skill evaluation of represented action, it is classified as, Expert class: members of table tennis club at university, Intermediate class: student who used to be members of table tennis club at junior high or high school, and Novice class: inexperienced students. It uses an integrated data-mining environment “weka” and analyze the data by C4.5, Native Bayes Tree (NBT), Random Forest (RF).As the main advantage, analysis and identification

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for internal models for technical skills as evaluation skillfulness for forehand stroke motion pictures of table tennis, and discuss mono and meta-functional skills for improving skills is implemented [2]

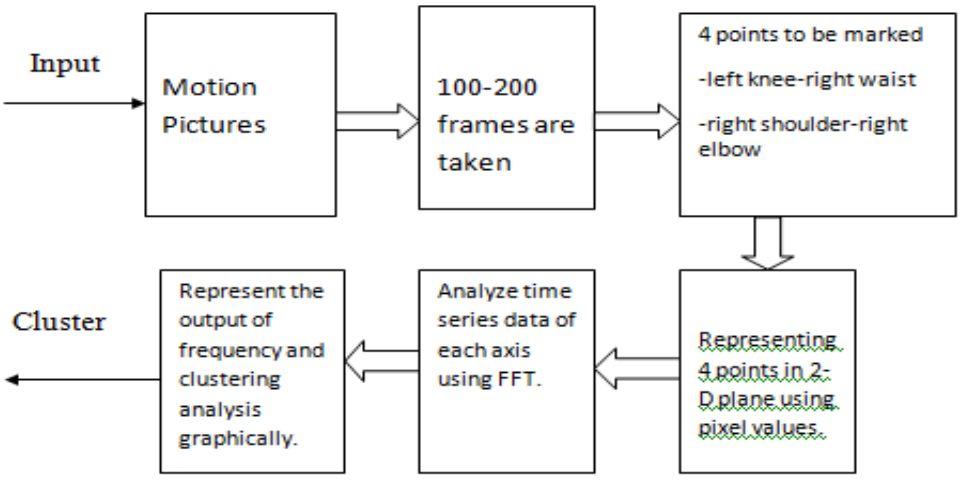
A time series data analysis for sport skill using data mining methods from motion pictures, focused on table tennis is presented. Use of high speed motion pictures, from which time series data are obtained and analyzed using data mining methods such as C4.5 and so on is done. Identification of internal models for technical skills as evaluation skillfulness for forehand stroke of table tennis, and discussion of mono and meta-functional skills for improving skills is performed. The research is to identify internal models from observed motion picture data and skill evaluation with represented actions, without measurement of the body structure or the skeleton structure. Analyze table tennis skills of forehand strokes from observed motion picture data and skill evaluation with represented actions. Analyze the data is done by analyzing methods of J48 (an implementation of C4.5), Native Bayes Tree (NBT), Random Forest (RF).

The reconstruction of time series data from the original data and analyze the new data by data mining techniques such as J48, NBT, RF, where the recognition rate for evaluation data is not so good, though J48 makes better results for learning and evaluation data. Two class analyses furthermore suggests Intermediate class may be categorized as Novice class [3]

A personal sport skill identification using time series motion picture data, focused on volleyball is done. Internal models for technical skills as evaluation skillfulness for volleyball attacks is identified, and discussion on mono and meta-functional skills for improving skills. For the feasibility research, motion pictures of 6 subjects who are 3 expert / 3 novice-level university students have been recorded. As skill evaluation of representing action, classifications of the levels are as follows, Expert class and Novice class and intermediate class is not considered. It uses an integrated data mining environment “weka” and analyze the data by analyzing methods of J48 (an implementation of C4.5) and NBT (Naive Bayes Tree). The main advantage is reconstruction of time series data from the original data is done and analyze the new data by data mining techniques such as J48, NBT, where the recognition rate for evaluation data is fairly good, and NBT makes better results for learning and evaluation data [4]

The study describes a method for the measurement of sports form. Data obtained by this system can be related quantitatively to skill criteria as expressed in respected golf lesson textbooks.This system yielded the following results. 1) Golf-driver swing expressed by a link model involving 12 rigid rods. 2) Under the link model, the method to measure 3-D rotation and estimate translation of the swing form was accomplished by applying the Euler transformation. 3) The measurement system is based on 3-D gyro sensors [5]

II. ARCHITECTURE DIAGRAM



The steps or methods followed to develop and implement the project is as follows. Using high speed camcorder, we capture motion pictures of 6 subjects(3 experts/3novice).

From the recorder motion pictures, 100 to 200 frames are retrieved from the beginning of take-back to the ball until the end of the attack. Marking of 4 points, that is left knee, right waist, right shoulder, right elbow is done for all the 6 players of x,y axis. Representing 4 points in 2-D plane using pixel values. Using an integrated data mining environment “weka”, we analyze the time series data using FFT(Fast Fourier transform) for each axis. Frequency and clustering analysis is done and it is represented graphically.

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III. METHODOLOGY

The steps or methods followed to develop and implement is as described below:

Using high speed camcorder, we capture motion pictures of 6 subjects(3 experts/3novice) .From the recorder motion pictures, 100 to 200 frames are retrieved from the beginning of take-back to the ball until the end of the attack. Marking of 4 points, that is left knee, right waist, right shoulder, right elbow is done for all the 6 players of x,y axis. Representing 4 points in 2-D plane using pixel values. Using an integrated data mining environment "Weka", we analyze the time series data using FFT (Fast Fourier Transform) for each axis. Frequency and clustering analysis is done and it is represented graphically.

1. Data Collection

We have recorded swing traces of stacks using a high-speed cam-recorder (resolution: 512 × 384 pixel and frame-rate: 300 frames per seconds) installed besides of the players. In playing in 5 minutes, several attack motions are recorded for each player.

2. Skill Analysis

In the recorded motion pictures, 210 to 360 frames are retrieved from the beginning of take-back to the ball until the end of the attack. We have then distributed two dimensional axes positions (pixel values) of four marking points for each frame, where the starting point is set at the shoulder position of the first frame. We analyze time series data of each axis using fast Fourier transform (FFT). All six subjects for left-knee X-axis. In this figure, n1,n2,n3 are from the data of novice subjects, and e4,e5,e6 are of expert subjects. This figure roughly suggest novice data tend to have high frequency. For further analysis, we focus on one novice (n2) and one expert (e4) subjects and present some spectrums of each axis.

3. Fourier Transform

The Fourier transform (FT) disintegrates a function of time signal into the frequencies. The complex-valued function of the frequency is Fourier transform of a function of time, whose complex argument is the phase offset of the sinusoid in that frequency, and the amount of that frequency present in the original function is represented by absolute value. Frequency domain representation of the original signal is called as Fourier transform. The term Fourier transform refers to both the mathematical operation and the frequency domain representation that associates the frequency domain representation to a function of time. The intensity of a signal is identified by its spatial position rather than at any point in time as in image processing the notion of a time domain is replaced by that of a spatial domain where.

4. Hierarchical Clustering

We make an attempt to classify frequency data using hierarchical clustering technique, and some have fairly good results. The result of left knee Y-axis, and this implies novices (n1,n2,n3) and experts (e4,e5,e6) can be clearly classified, though other axes data are not clearly clustered. The up-down movement of left-knee should be essential for volleyball attack skill, and further investigation seems to be needed for certify this hypothesis.

CONCLUSION

This paper presents sports skill classification using time series motion picture data, focused on volleyball. Time series data are obtained from the motion picture data with marking points, and analyzed using FFT and then clustering techniques. We classify technical skills of volleyball attacks.

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