Analysis of the characteristics of throwing techniques in martial arts

UDC 796.8

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Abstract

Objective of the study is to identify the biomechanical characteristics of technical and tactical movements based on an analysis of the trajectories of the centres of gravity of various segments of the athlete's body.

Methods and structure of the study. During a match, the athlete performs movements, including those influenced by a force field. To characterise the field, a model comprising 14 segments of the human body was used. Using artificial intelligence, programmes have been developed that enable the calculation of the trajectories of the centres of gravity of the body segments and the saving of the resulting data to separate files.

Results and conclusions. Based on the trajectories of the centres of gravity of the body segments, the nature of the force field at various points in space was determined. Analysis of these trajectories has provided objective insights into the execution of technical and tactical movements by highly skilled athletes, enabling the exploration of new approaches to designing the training process. The use of the proposed analysis in the training process will improve the performance of students in competitive activities and increase their motivation to continue practising martial arts.

Keywords: *martial arts, analysis, judo, technical and tactical training, characteristics.*

Introduction. Technical and tactical training in combat sports is a constant focus for coaches and athletes [1, 5, 6]. It is vital to analyse opponents' bouts in a timely manner, identifying the nuances that are utilised in the process of developing and executing techniques [2, 3]. Undoubtedly, it is important to pay attention to lost matches in order to identify the causes of defeat and avoid mistakes in the future. This is not always possible based on a visual analysis of the bout. However, an adequate analysis of the athlete's body movements using the proposed methodology solves this problem. To understand the essence of the action, it is necessary to select the appropriate set of characteristics that would allow for an accurate description of the biomechanics of the constituent movements [4, 7].

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Results of the study and discussion. Based on the shape of the trajectories of the body segments' centres of gravity, it is possible to draw conclusions about the nature of the force field at various points in space. It is also possible to track the movement of each body segment and note the nuances of movement which are not usually taken into account when viewing a video recording.

Below is an example of an analysis of the force field in which an athlete operates. However, the parameters that should be included in the analysis are determined

a) b) c) d) e)

Figure 1. Phase one: Drawing the opponent's attention to the right with a feint

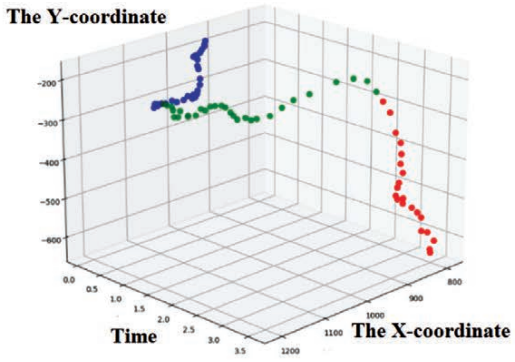
a) b) c) d) e)

Figure 2. Phase two. Driving the opponent to the left

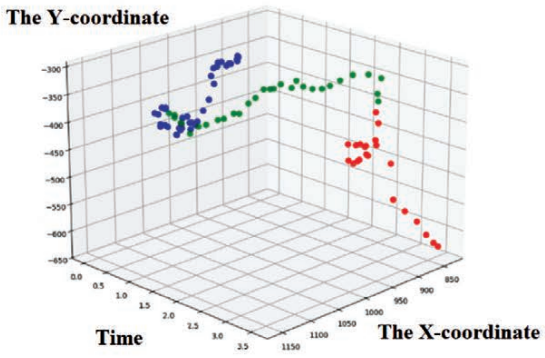
a) b) c)

d) e)

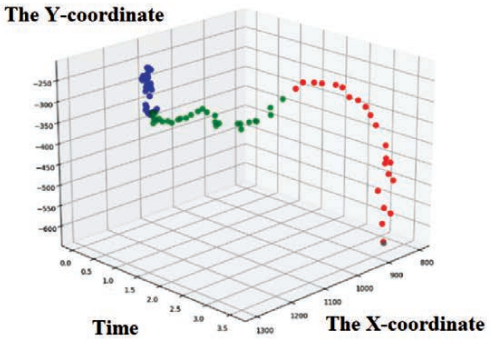
Figure 3. Phase three. Executing the throw



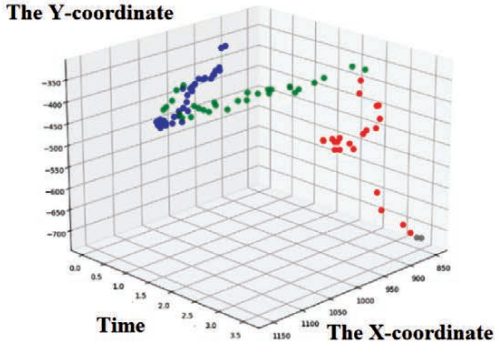
a) The trajectory of the head's CG



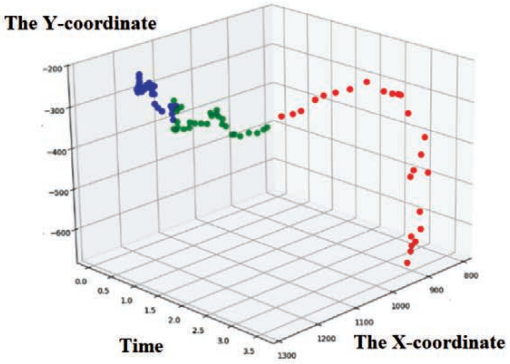
b) The CG trajectory of the left shoulder



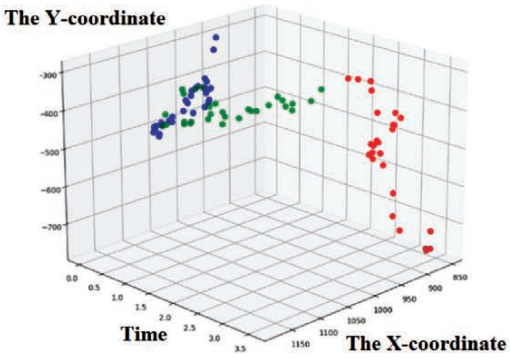
c) The CG trajectory of the right shoulder



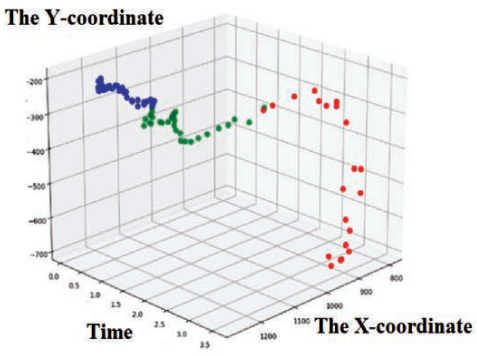
d) The CG trajectory of the left forearm



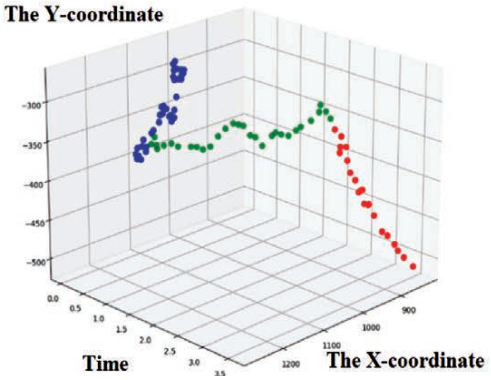
e) The CG trajectory of the right forearm



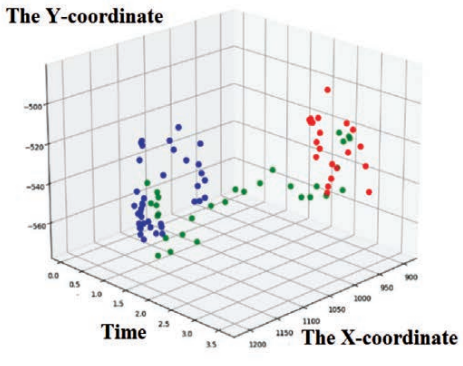
f) The CG trajectory of the left wrist



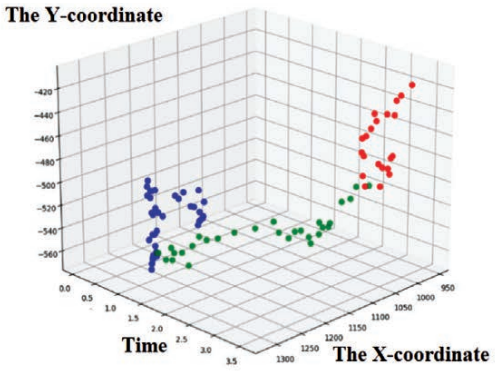
g) The CG trajectory of the right wrist



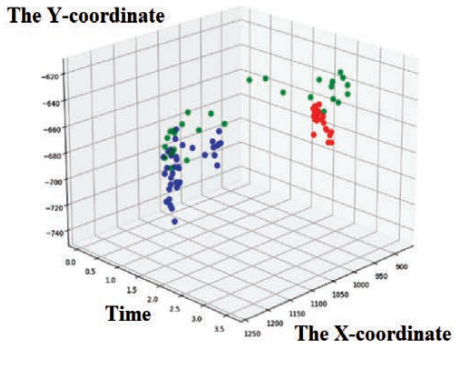
h) The CG trajectory of the torso



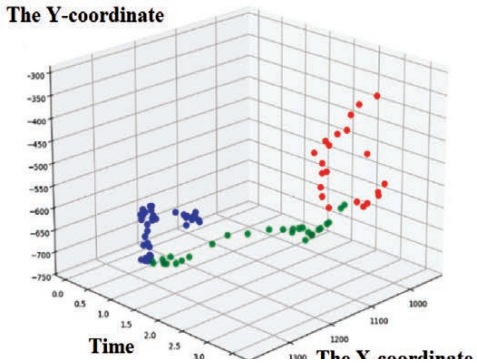
i) The CG trajectory of the left thigh



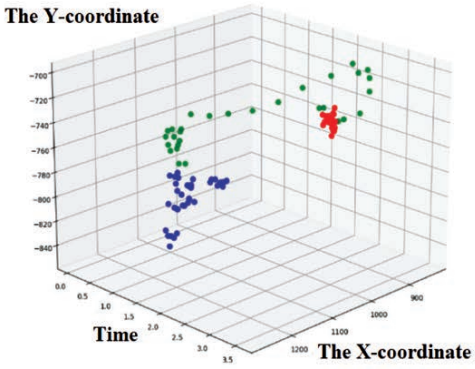
j) The CG trajectory of the right thigh



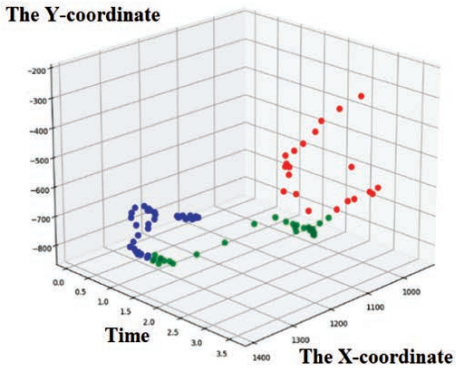
k) The CG trajectory of the left lower leg



l) The CG trajectory of the right lower leg



m) The CG trajectory of the left foot



n) The CG trajectory of the right foot

Figure 4. Trajectories of the centres of gravity (CG) of body segments

not by a strictly regulated methodology, but by the specific situation under investigation.

The analysis was conducted on a video recording in which Dorsel Yandzu demonstrated a lift throw, similar in structure to the judo Yama-arashi throw technique [8]. A 3.56-second segment was extracted from the recording. It comprises three phases:

- movement to the right, distracting the opponent with a sweep;
- movement of the opponent to the left, with the aim of accelerating the opponent;
- execution of the throw.

The trajectories of the centres of gravity of all 14 body segments were used for the analysis.

Figure 1 shows the first phase of the technical-tactical action.

Figure 2 shows the second phase of the technical-tactical manoeuvre, which involves a 'sprint' to the left.

Figure 3 illustrates the throwing phase.

Figure 4 shows the trajectories of the body segments throughout the entire technical movement. The first phase is shown in blue, the second in green, and the third in red.

The force field within which an athlete moves is not