deformation and degree of flat feet. Later, when the position of the feet is restored, special exercises are performed at least 3 times a week. The important thing is the conscientious attitude of the students to the practical recommendations of the instructor and the performance of self-exercise physical exercises.

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К. К. Bondarenko

BIOMECHANICS OF MARTIAL ARTISTS INTERACTION DURING THE EXECUTION OF TECHNICAL ELEMENTS

The article is devoted to actual problems of determination of biomechanical parameters of movement during a competitive match. It examines the characteristics of movements and positions when a pair of athletes interact. The issues of the development of traction and pushing efforts of judoists in the performance of basic motor actions are considered. There are characteristics of the movement, which are fundamental to the achievement of sports results in most types of martial arts. This predetermines the evaluation of sports actions taking into account the biomechanical components of motor actions.

The study of the interaction in martal art can be approached by means of biomechanical characteristics of motion under static conditions [7]. This can be determined with the help of classical motion analysis systems allowing to combine results of structural elements [9].

There is a differential analysis method used in the study of throw technique. As a rule, motion is divided into three distinct phases: imbalance, positioning, projection, (Kuzushi, Tsukuri, Kake) [2]. At the same time, in all types of martial arts, there are two main stages of training technical actions, namely, the study of technical interactions in the pairing system of athletes and the movement system of the pair of competing athletes [3].

In the phases of the destruction of balance – Kuzushi and creating the precondition for the throw – Tsukuri, identifying the structure of the movements, are invariants of general action. The specific invariants of action are the throwing techniques that do not require imbalance. In addition,

common should include the identification of techniques requiring a certain time condition, using only general options for simple movements with lower energy consumption [8].

Identification of methods requiring large coordination abilities, using both general invariants and specific invariants, implying complex movements with high energy consumption.

For the throw phase (Kake), it is necessary to apply two biomechanical principles underlying all methods, namely, the determination of the basic movements applied to each group of throw techniques, determination of static and dynamic parameters of force use for the execution of the throw, identification of mechanisms that play an essential role in the creation of forces, identification of the main trajectories of movement of the body, which are structural components of partial symmetries, which means they represent the lowest-energy trajectories for the attacking athlete [11].

All possible projection methods can be classified only according to two main biomechanical criteria, namely, the use of force pair and the application of the lever [6].

The next components of the throw projections (in particular in judo) belonging to these groups are the torque force and the arm of force [4].

In order to assess the nature of the fight, methods of control and immobilization according to the action are classified. At the same time, it is necessary to determine the active and passive role of kinetic chains in the fixed assets. To this end, the main mechanisms of technical actions shall be determined and the physical and biomechanical bases of the methods of the resulting forces of the lever [1] shall be analysed.

The physical characteristics of competitive activity reveal the forces acting on athletes. Such forces shall include the force of gravity, the force of impact or thrust caused by the opponent, and the friction force arising between the athlete and the support [5].

From a biomechanical point of view, an athlete can be described as a solid with variable geometry and cylindrical symmetry, which through the joints can perform only certain types of rotational actions. In the analysis of competitive activity in martial arts, the action system of a pair of athletes can be defined as the aggregate of a system with cylindrical symmetry formed by the semi-rigid union of two bodies. Such a system may have varying degrees of freedom. It would therefore be useful to analyse movements using methods specific to kinematics. This allows the determination of values that can be tested and evaluated [10].

The following action is based on the theory of closed biokinematic chains, through which the interaction of a pair of athletes is analyzed. This predetermines the fact that mass, speed, energy and other values should always be understood as the properties of the whole pair, not the individual athlete.

Considering the pair of athletes moving on the judo mats, it can be concluded that it makes «random» movements caused by increasing or decreasing speed. The nature of the pair's movement or the rapid change of direction caused by the resulting forces generated by the two athletes to create the appropriate situation is related to the previously mastered technical actions of one of the two athletes. At the same time, the term «random» implies a condition that with a large number of fights there should not be a pattern of movement.

Athletes' performance is generally assessed by means of an axial-coordinate projection. At the same time, a comparison of kinematic parameters of motion of the knee joint and the nature of the angle of rotation of the shoulder joints in the horizontal plane was evaluated. In each of the nodes the common center of mass of the attacking athlete – Tori ($COM_{(t)}$), defending athlete – Uke ($COM_{(u)}$), and the system of body interaction ($COM_{(C)}$) was determined. The instability angle of the body system ($\varphi_{(c)}$) is defined as the angle between the support point and ($COM_{(C)}$) relative to its height (h-$COM_{(C)}$). The distance from the support point to the projection point ($COM_{(C)}$) shows the relation to the stability limit of the body (d_{lim}). In order to determine some of the factors that determine the variation of the stability angle, the torso angle of Tori is calculated relative to the horizontal line ($\varphi(h)$). For this, the torso is defined as a position vector, the proximal point of which is the coordinates of the (x, y, z) pubic point, and the distal coordinates of the (x, y, z) supraspinous point (Figure 1).

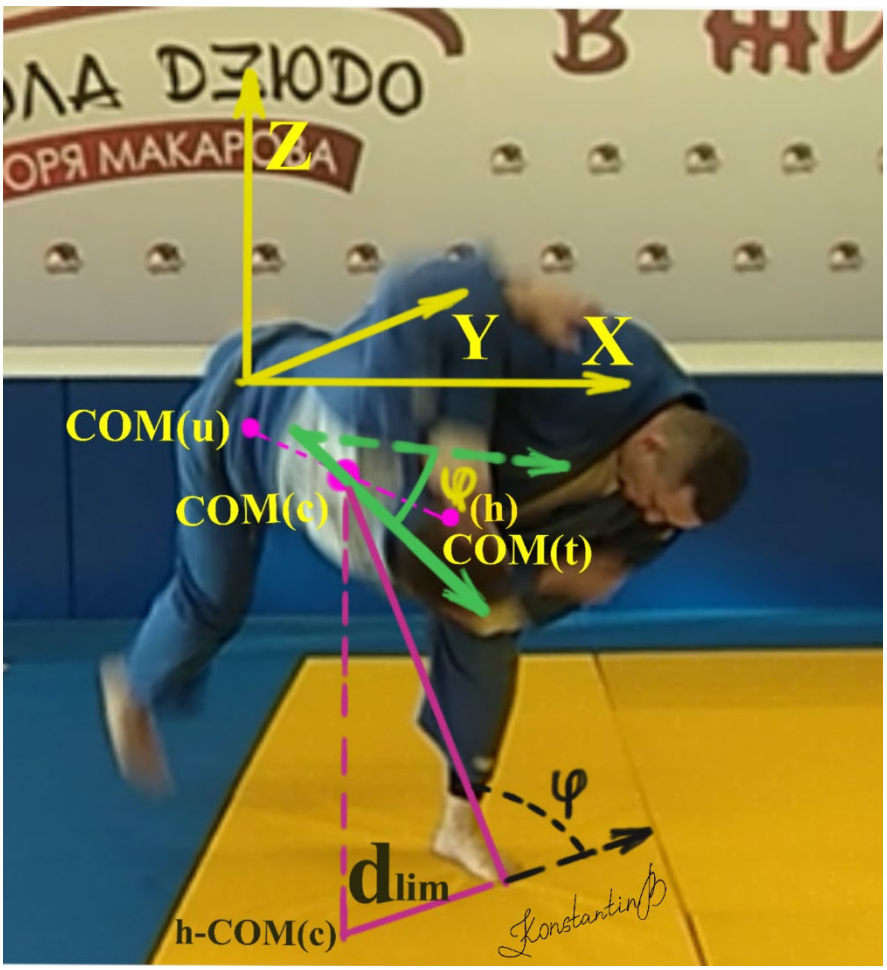

Figure 1 – Diagram of determination of stability angle of position of bodies of athletes at the moment of execution of roll

In a closed system of biokinematic chains in a couple of athletes when stabilizing the position, «random» movements can contribute to the creation of a situation that allows the use of previously automated actions. This happens in many ways when the nature of chaining with support changes under Newton's third law. The general equation describing this dynamic situation is Newton's second law, which defines the force of action as the product of mass at acceleration. In this case, the force created may depend on both the nature of the body's grip with the support, and the nature of the traction and push forces. The component of interaction with the support (friction) is proportional to the speed. Changes in speed and direction determined by the respective traction and push forces depend on the resulting forces created by the pair of athletes. They are impulses that operate for very short periods of time. Thus, variability of action can be expressed by standard deviation (δ) and elementary force (u). Где u – фактически представляет собой изменение импульса m ∗ Δv: $\varphi_{(t)} = u * \sum_j \delta * (t - t_j)$.

The result of the action is determined by the algebraic sum of traction and push forces, which also must take into account random changes in direction (described by changing the sign (1) j of elementary force).

Общую силу можно представить как: $\varphi_{(t)} = u * \sum_j \delta * (t - t_j) (\pm 1)_j = F'$. Следовательно, суммарная сила равна $F = F_a + F'$, и общее уравнение движения можно представить как $\dot{u} = -\frac{u}{m}v + \frac{u}{m}\sum_j (\pm 1)_j * \delta * (t - t_j) = F_a + F'$.

As a result of traction and push forces of «random» type, it is impossible to predict the trajectory of movement in a single match. At the same time, the analysis of actions in fights in various competitions, allows you to obtain important information about the behavior of the system.

Since the changes of direction are uniform, that is. e. with a large number of fights held there is no preferred direction, then the average value of the total force in time F' in a random sequence of directions is zero F' = 0. If the product of traction and thrust forces is considered and averaged in time and directions, information about the change of force over time can be obtained. Testing these conditions suggests that the movement of athletes can be described in kinematic parameters as a movement related to the structure of Brownian movements on an infinite surface. In this case, the moment of movement can be represented as f(x,t)*dx, which characterizes the probability of finding the common center of the pair of athletes in the position x of the interval dx at time t. This probability satisfies the Fokker-Planck equation describing the change in the continuous distribution of the probability of being present during the fight.

Analyzed a special class of events, formed by unique situations, occurring in «random» with a certain probability of frequency on a large number of events, allows us to state that, the results of research of trajectories of movement of the system «Pair of athletes» during the match, confirmed by an experimental test.

From a biomechanical point of view, judo competitions are a complex, non-linear system with «chaotic» movements. The competition is actually a test stand, where both the professionalism of the coach and the skills of the athlete are evaluated.

Competition is an indicator of the effectiveness of time spent by an athlete on physical and technical training, as well as the culmination of performance in terms of training. It is also the most important source of technical information. Therefore, the analysis of competitive activity is necessary for coaches to obtain useful information on the effectiveness of their training methods.

Competition analysis should be seen as the cornerstone of understanding situational sports such as judo or karate. This is an important auxiliary tool in the difficult task of the coach to prepare the athlete to achieve the highest sports result.

Analysis of competitive fights is a valuable source of information on the physical and functional state of the athlete's systems, the perfect mastery of the necessary technical elements and tactical skills.

Biomechanical analysis of competitive activity should be applied to the system of «pair of athletes». This allows you to identify features that are constant in the competition. They can be classified in terms of the biomechanical principles associated with enemy capture.

Martial arts refer to difficult coordination sports with a frequently changing situation. Situational sports are those sports in which the achievement of sports results cannot be identified as a simple system of movements, which are performed when there are one or more opponents.

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N. A. But-Husaim

NEW APPROACHES TO THE PRIMARY SELECTION OF YOUNG ATHLETES IN THE INITIAL TRAINING GROUPS IN ATHLETICS

The article reveals the features of the primary selection of children in 2-4 grades of Belarusian schools by means of the republican sports and mass project "300 talents for the queen". Participation in the project allows you to increase the level of children's motivation for athletics and is one of the stages of selection in initial training groups.

Today, more and more people are involved in sports activities. Athletics is one of the most massive and popular sports, which has a number of advantages over other sports - accessibility and popularity, low level of injuries, a dense schedule of different ranks of competitions and others.

However, there are a number of problems among which can be distinguished:

– lack of coaching staff of high qualifications;

– weak material base;

– increasing competition (especially game sports);

– the late age of the start of classes in comparison with other types;

– not a particularly attractive competitive system (especially for children).