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APPLICATION OF MODERN INFORMATION TECHNOLOGIES OF FEEDBACK IN IMPACT MARTIAL ARTS ON THE EXAMPLE OF TAEKWONDO WTF

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Abstract:
The article deals with topical issues related to the use of feedback information technologies. Since there are not so many studies on this topic, the review includes information on the example of other sports where research is already being carried out, as well as preliminary own research obtained on the example of athletes of percussion martial arts, taekwondo WTF. The study examines the main parameters of the kinematics of the movement of athletes, the study of which allows us to evaluate their effectiveness, and the magnitude of the impact, primarily when assessing the external side of the load. Feedback information technologies for continuous monitoring of motor activity are currently informative, reliable tools in the work of coaches, the information from which helps to plan the training process and carry out the continuous process of training an athlete both in different periods of the annual cycle and during the recovery period.

Keywords: athletes, technology, feedback, percussion martial arts

1. Introduction

At present, a lot of information has been accumulated about the management of the training process based on feedback technologies. For a long time, technology was built on the basis of heart rate monitoring. The criterion for the magnitude of the load was the target value of the pulse, which must be achieved and held for some time to achieve the required energy supply mode [1]. Based on this, a conclusion is made about the physiological or pedagogical orientation of the lesson, and the load performed. This

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feature is typical for representatives of both cyclic and team sports. With the growth in the number of information technologies, and new systems for recording the movement of athletes, it becomes possible to obtain new information about the external load value and compare it with the internal one, for example, with the heart rate, the most accessible for measurement and evaluation, that is, use a different approach in assessing the load value. Over the past decades, motion activity monitoring systems have become an integral part of obtaining information on the most important physiological indicators, contributing to injury prevention, and improving adherence to exercise in various sports fields, from professional athletes to patients in rehabilitation centers. Modern integrated systems make it possible to conduct high-quality and informative experiments for the quantitative assessment of the athlete's neuromuscular load.

2. Literature Review

A review of information sources on the topic of the study allows us to make a high relevance of the study of this topic by different specialists. So, Gomez-Carmona [2] and co-authors conducted studies of an inertial sensor device (Wimu Pro) in various conditions: on a treadmill and a sports track in order to determine the effect of an external load on the neuromuscular during running and to evaluate the internal value of the load on heart rate and a sensory sensor monitoring the concentration of oxygen in the muscles (MOXY) - near infrared range. Data recording devices were attached to: scapula, common center of mass, knee and ankle joints. As a result, the system has established itself as a high-precision equipment, which can be used to obtain data correlating with laboratory equipment. When determining or fixing the necessary parameters, the location of the sensor should be on the corresponding segment for the purpose of the greatest accuracy: in running on the ankle, in alpine skiing at the level of the common center of mass, and so on [3]. Pino-Ortega [4] et al. conducted a comparative analysis of the assessment of the vertical jump of football players using an inertial device (Wimu) and a special platform, using the flight time as an assessment. The results of the study showed high reliability, reliability and reproducibility of the data.

Ibata [5] et al. studied the three-dimensional trajectory of movement during standing long jumps using Wimu feedback systems. A three-dimensional trajectory of movement was created by fixing wireless devices under the chest, right thigh and right shin. Pressure sensors are synchronized with WIMU and installed under the right heel and toe to distinguish between the state of body movement between landing and jumping. The initial and final position of the torso, thigh and lower leg in a stationary state is obtained using gravitational acceleration and geomagnetism. The position of the body was determined using the 3D direction of each segment, updated by numerically integrating the angular velocity. In-flight motion is determined by pressure sensors and the 3D flight path is determined by double integrating the barrel acceleration using the 3D takeoff velocity of the barrel. The results of the study showed a high correlation between angular velocities and flight trajectories with indicators measured by optical

cameras. Thus, modern feedback information devices are an important and informative tool for assessing the kinematics of the movement of athletes, including in real-time. Received the results of the study confirm the data of Granero-Gil [6] and co-authors, who studied various factors of the kinematics of movement in football and on which the result depends.

3. Material and Methods

In order to test the hypothesis and the feasibility of using modern information technologies, a preliminary experiment was conducted with the participation of athletes of highly qualified percussion martial arts, taekwondo WTF. Qualification of the master of sports 8 athletes were examined. The GPS/LPS system, RealTrack System, Wimu Pro, Spain, was chosen as the system for recording motion parameters. The system has a built-in accelerometer (1000 Hz), a magnetometer (100 Hz), a gyroscope (1000 Hz), a barometer (100 Hz), an internal data storage device, and the duration of continuous operation is 3 hours. All information is transmitted in real-time to a device located in a special vest-shirt on the back, in a specially made pocket, between the shoulder blades. If necessary, data can be transmitted in real-time with a resolution of 0.5 s. The sensor size is 4x8 cm. Bastida-Castillo studied the data acquisition technology for informativeness, reproducibility and reliability [7]. The fight was recorded on digital media using a Go Pro HERO8 Black camera. Further, the resulting image was integrated into special software for subsequent data synchronization and analysis. At the same time, the heart rate was recorded using a Garmin chest heart rate monitor, which has synchronization with the WIMU device, and also allows recording cardio intervals of the heart rhythm. Athletes performed the task in the form of sparring according to the rules of the competition, with a judge, 3 rounds of 2 minutes.

4. Results and Discussion

The results of the study are shown in Figures 1-3. As shown in Figure 1, on the left side, there is a heat map of the volume of space which athletes occupy during the fight. The perimeter of the circle is indicated by different colors corresponding to the front (blue), side and back (gray line) lines. The advantage of using this method is to obtain objective information by measuring the main kinematic characteristics of movement in the process of continuous performance of various motor actions, including translational and rotational movements. The measurement of temporal characteristics reveals a movement in time: a moment in time, pace and rhythm of movement. The classification of biomechanical characteristics related to kinematics is subdivided into displacement, acceleration and speed, which are parameters of the external load value. Thus, knowing the parameters of the external value of the load, it becomes possible to study the factors that determine the effectiveness (efficiency) of movements (Figure 2).

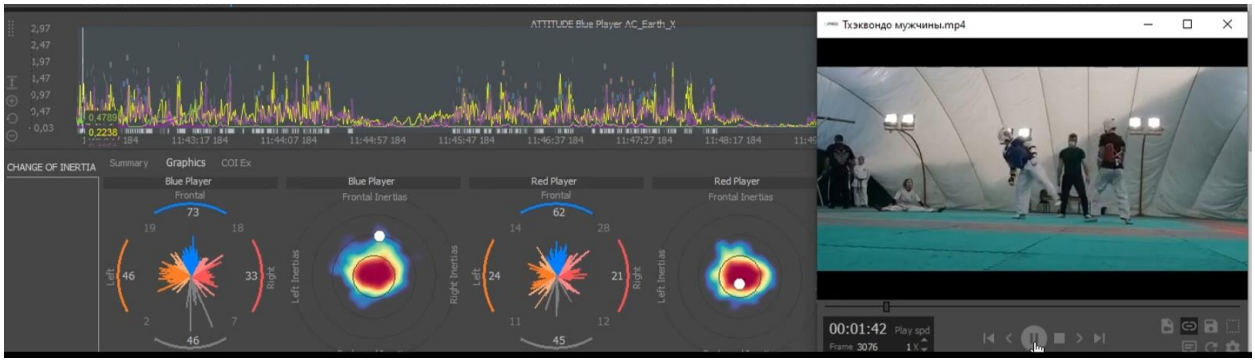

Figure 1: Practical demonstration of the use of an information feedback system for recording motion parameters

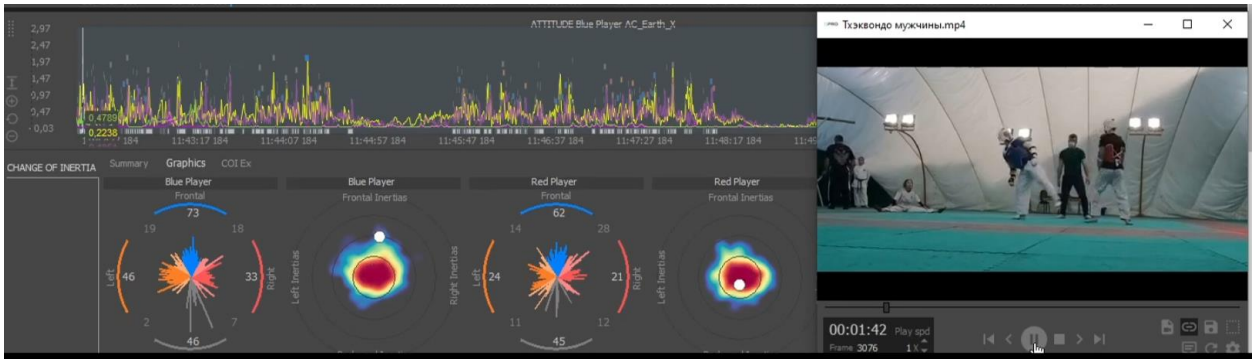

Figure 2: A copy of the screen with heart rate data (upper line), vertical speed (middle line), angular velocity (lower line)

One of the advantages of using modern feedback information systems is the evaluation of the parameters of translational and rotational movements. It can be seen from the figures presented that the duration of a single movement is very short and can be less than 2 sec, while in cyclic movements it can last from 10-50 sec to several hours. In 2 sec the athlete can perform a technical-tactical defensive, provocative, or attacking action, a series of motional actions with both hands and feet. In fact, for two minutes of the round, heart rate indicators reach a plateau only at the end - 177 beats/min, and recovery by the beginning of the second round - 140 beats/min (Figure 3). The magnitude of the load, in this case, will be determined not by the quantitative value of the heart rate, but by the applied muscle efforts (power) during the movement.

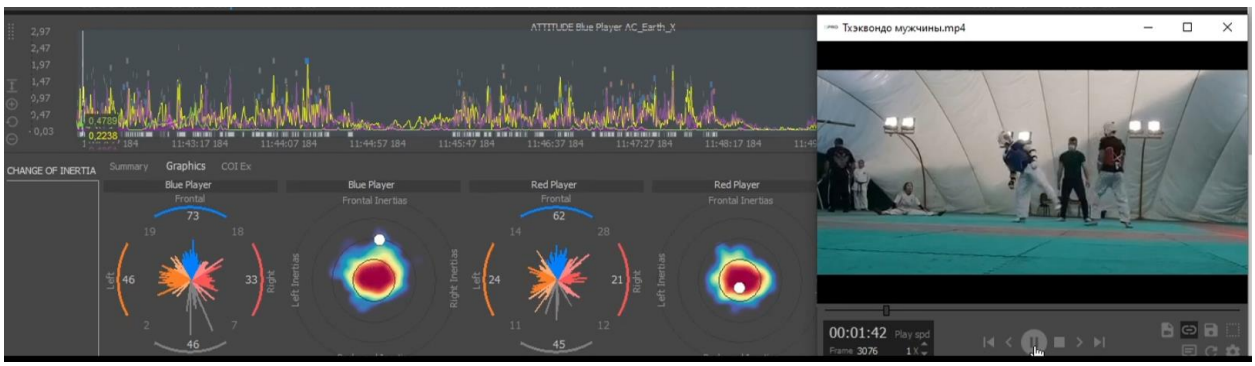

Figure 3: A copy of the screen with data corresponding to the end of the first round

The following studies will focus on the study of the range of motion of various segments. As well as obtaining statistical data of various motion parameters. The information obtained in the process of this type of training exercises, their quantitative and qualitative distribution in both competitive and training activities, including integral training, which is relevant. Godik [8] classified motor activity according to intensity: slow, accelerated, sprint, and also represented the energy parameters of some motor actions, however, the author does not provide information about the distribution of motor activity parameters and the method of its measurement, since information means for monitoring the fixation of these parameters appeared relatively recently. Modern information tools that record movement parameters make it possible to obtain new information about, and classify according to intensity ranges [9, 10]. García [11] with co-authors showed the distribution of motor activity parameters on the example of basketball: maximum speed, km/h; total distance, km; running at high speeds above 18 km/h; jumps above 3g (a unit of free-fall acceleration); collisions above 8G; high-intensity acceleration (≥ 2 m/s^2) and deceleration (≤ 2 m/s^2), the authors pay attention to these parameters as the main parameters characterizing motor activity. Vazquez-Guerrero [12] with co-authors obtained similar results and focused on measuring acceleration, that is, the player's ability to quickly change speed, which ultimately determines his speed-strength abilities. Reche-Soto [13] et al. made an attempt to study the parameters of metabolic power in various intensity exercises, since this line of research is currently relevant [9, 10]. Evaluation of the basic movements of athletes, classified by the kinematics of movement, allows us to evaluate their effectiveness in a new way. The main advantage when working with feedback information technologies is that the assessment of actions is carried out immediately for two athletes who are in a pair, and therefore, those techniques and actions that they perform against each other.

Thus, we obtain reliable information about the quality of the exercise being performed, and we evaluate the actual integral type of training, minimizing the subjective approach in assessing the exercise by «eye».

5. Conclusion

The essence of the management of the training process is expressed in the change in the state of the controlled object (system) in accordance with a given criterion for the effectiveness of its functioning and development. The effective development of such a dynamic system as an athlete is possible only with a competent construction of the training process, which must first of all include the determination of the initial parameters of the system. The more parameters of the system are known and the more clear are the patterns of relationships between these parameters, the more predictable for the coach are the results that an athlete can achieve in the near and distant future. When managing the training process, it is unacceptable to refer to the system-athlete as a "black box", where there are only input data in the form of a training load, and output data - the result of work in the form of results of competitive activity. Thus, the use of innovative

systems for recording the movement of athletes is relevant at the present time and is used to increase the effectiveness of the training process.

Conflict of Interest Statement

The authors declare no conflicts of interest.

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