

METHODOLOGY AND RESULTS CONNECTED TO THE SPORTS TECHNIQUE IN SHOT PUT

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Abstract: The aim of the research is to develop an apparatus system for objective registration of specialized motor activity and to obtain informative data for management of sports training in athletic throwing games.

The system is built from functionally integrated units - three-dimensional tensometric platform connected to a multichannel tensometric amplifier and a multichannel analogue-to-digital converter, optic registration module including a 10.1 megapixel Casio EX-FH25 digital camera, computer accessories, specialized SpringRS and Kinovea software products.

The complex apparatus was tested in experimental studies with three different types of skilled athletes in shot put. Simultaneously the dynamic changes of 46 indicators are measured, informative about the sports technique and specialized power possibilities of the competitors.

The comparative analyzes made lead to objective assessments of the condition of factors of great importance for sport training.

Key words: methods, results, sports technics, in shot put

1. Introduction

Control and measurement in sport are an integral part of sports metrology. Its content includes, in particular, control over the athlete's condition, the technique of movement, training exercises, sports scores, as well as the comparison of the data fixed in each of these directions, their assessment and analysis [6]. The most significant issues in sports metrology are in the field of proper measurement and assessment in sport. Such are the measurements and evaluation, for example, of sports equipment in athletic throws[4].

Sports equipment is a "specialized system of simultaneous and consecutive actions aimed at the rational organization of the internal and external forces acting on the athlete and their fullest use in solving a particular motor task" [5].

The control of the "motor structure" of the sporting equipment is performed integrally by combining data from measurements of dimensions and indicators characterizing in parallel "causes" and "consequences" for a particular motor activity and respectively - assessment of the level of the sports equipment [1].

Guided by the above, we assumed that by creating an apparatus for measuring and recording specialized motor activity, control and management of sports training in some sports and disciplines will be improved [3]. An example of our research will be the measurement of sports equipment in athletic throws, and more specifically in the discipline shot put [8].

2. The aim is to develop an apparatus system for objective registration of specialized motor activity and obtaining informative data for management of sports training in athletic throws.

3. Tasks of research

1. Development of an apparatus for measurement of specialized motor activity and obtaining of informative data for management of sports training in athletic throws.

2. Conducting experimental research and applying an adequate software product for computerized processing of the defined indicators.

3. Approbation and presentation of a concrete example of measurement of the sports technique in shot put.

4. Methods of research

The following research methods were used: information research; apparatus measurements; experimental sports-pedagogical research; mathematical-statistical methods; comparative theoretical analysis and synthesis; expert analyzes.

5. Results received

For the realization of the main goal we developed the following equipment: For the direct measurement of dynamic parameters was used the instrumentation set up: a three-dimensional strain gauge attached to a multichannel strain gauge amplifier and multichannel analogue-to-digital converter by V. Bachev

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and colleagues (2012) [2]. The information received from the measurements is transmitted to a computer connected to it by a monitor and an external printing device (Fig. 1, Fig. 2).

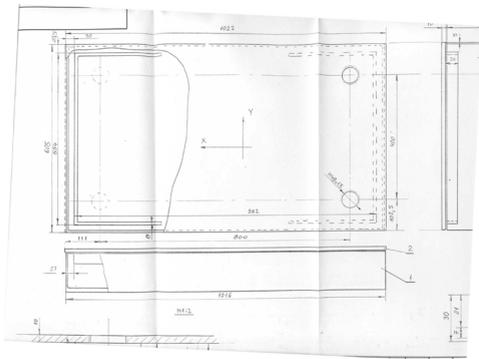


Fig.№1 Sensor platform

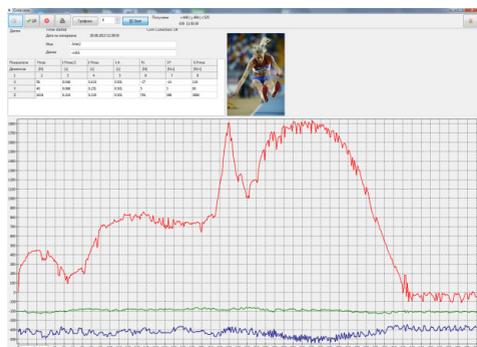


Fig.№2 Original results from the tests

We added a 10.1 Megapixel digital camera CasioEX-FH25 module to this camera kit; specialized software products "SpringRS" and "Kinovea".

A series of pilot experimental studies was conducted to approbate the complex apparatus system. It was found that simultaneous registration of variations of a large number of indicators, informative for characterization and evaluation of sports equipment, is possible. The measurements obtained from the three-dimensional platform are presented by an author's team at the international conference in Sozopol 2014 [4].

The obtained informative indicators from the kinematic analysis are:

1. Ankle speed when jumping on planes X and Y;
2. Acceleration of the ankle joint at the jump on planes X and Y;

3. Knee joint velocity at X and Y plane jump;
4. Acceleration of knee joint at jump in planes X and Y;
5. Pelvis velocity at jump in planes X and Y;
6. Acceleration of the pelvis in the X and Y plane;
7. Right-leg velocity at the X and Y plane jump;
8. Acceleration of right leg at jump in planes X and Y;
9. Shot velocity at the jump in planes X and Y;
10. Acceleration of the shot at the jump in planes X and Y;
11. Ankle velocity at the final effort on planes X and Y;
12. Ankle acceleration at the final force on planes X and Y;
13. Knee joint velocity at X and Y finals;
14. Acceleration in the knee joint at the final effort on planes X and Y;
15. Pelvis velocity at final effort on planes X and Y;
16. Pelvis acceleration at final force on planes X and Y;
17. Shoulder velocity at final effort in planes X and Y;
18. Shoulder acceleration at the final force on planes X and Y;
19. Shot velocity at final effort on planes X and Y;
20. Acceleration of the cannula at the final force on planes X and Y;

Experimental research with the instrumentation system was conducted with three different qualifiers skilled competitors in the shot put. We have focused



Fig.№3 ,№4 Original pictures from jump and final phase in shot put

on this discipline of track and field athletics, as the sporting result depends on both the physical qualities of the athlete and the technique of performance. The venue was at the covered athletics track of NSA "Vasil Levski", the camera was placed on a tripod 200 cm from the platform and at a height of 160 cm (Fig. 3, Fig. 4). Motion capture is performed in Slow Motion mode at a shutter speed of 150k/sec. The measurements were focused on the preparatory phase (jump) and the final phase of the shot put.

Data from the amendments of indicator №19 for three athletes, two of them being highly qualified national competitors - A, B and C are presented in table 1,2,3.

Table №1 Vertical and horizontal velocity data of the shot put. at the final phases athlete A

Shot put -X	m/s	1.592	3.488	6.026	6.346	5.394
	time	0.09	0.18	0.28	0.37	0.46
Shot put-Y	m/s	0.328	2.856	6.658	9.818	13.62
	time	0.09	0.18	0.28	0.37	0.46

For athlete B, the results are presented in table. № 2.

Table №2 Vertical and horizontal velocity data of the shot put. at the final phases athlete B

Shot put -X	m/s	6,476	6,942	4,612	3,214	6,01
	time	0.04	0.08	0.11	0.15	0.19
Shot put-Y	m/s	5,544	1,806	3,68	2,272	8,806
	time	0.04	0.08	0.11	0.15	0.19

For athlete C, the results are presented in table. № 3.

Table №3 Vertical and horizontal velocity data of the shot put. at the final phases athlete C

Shot put -X	m/s	-0.198	3.708	5.94	13.194	22.69
	time	0.07	0.15	0.22	0.29	0.38
Shot put-Y	m/s	0.36	1.476	3.708	9.288	22.69
	time	0.07	0.15	0.22	0.29	0.38

For the three athletes, the shortest time is for the athlete B, but the speed is very variable. Less time is a prerequisite for greater explosion in both the horizontal and vertical plane of the athlete when the appliance is pushed. In terms of speed, which is a significant factor in the shot put, the longer run time and the higher the speed are a prerequisite for a better sporting achievement. At athlete A, a constant increase in speed is observed with the continuation in the shot put time, which is a good sign. The highest speed for this athlete is 6.346 m/s in the horizontal and 13.62 m/s in the vertical plane. At athlete B, the vertical and horizontal velocity in the shot put at the final effort is weaker, the speed is the smallest, respectively 6.942 m/s and 8.806 m/s. moreover, this athlete is experiencing a non-steady speed at different time intervals. At the athlete C observed, the highest speed and incremental increase over each time interval - 22.69 m/s in the vertical and horizontal plane. It can be summed up that of the three athletes, the highest speed has a competitor B. This is also confirmed by table 3. In addition to the analysis of athletes' sports equipment, it is confirmed that speed and time are extremely important factors for achieving a high sporting result. In the same direction in figure 5, an original speed record is also presented in the ankle joint.

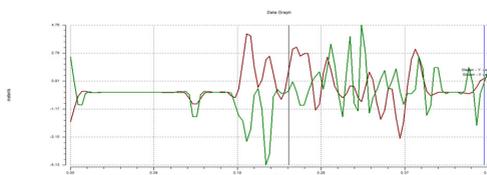


Fig.№5 Original record of vertical and horizontal velocity of ankle joint at the final effort

6. Conclusion:

1. Development of and experimentally probing our system gives grounds to indicate that a number of the building indicators and their integration form positive and informative trends in the direct control of the training process, effective assessments and forecasts of sporting achievement.

2. Simultaneously measured the dynamic changes of 46 indicators, informative about the sports equipment and specialized power of the competitors.

3. The comparative analyzes made, lead to objective assessments of the state of the factors conducive to sports training.

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