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METROLOGICAL ASPECTS OF RESEARCH ASSOCIATED WITH PARTIAL EVALUATION CRITERIA OF SPORTS EQUIPMENT IN SPORTS WITH SPEED-POWER MANIFESTATION

(Research note)

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Abstract

The aim of our research is to determine the metrological requirements for the necessary equipment - a three-dimensional computerized tensiometric research platform for the development of partial criteria for the evaluation of sport equipment in sports with speed-power manifestation. We have applied the methods of information study; expert evaluation and analysis; modeling; preliminary experiments; theoretical analysis and synthesis. Clear metrological requirements have been established concerning the construction, the preliminary preparation and functioning of the three-dimensional computerized tensiometric platform, used in the development of partial criteria for the evaluation of sport equipment in sports with speed-power manifestation.

Keywords: *metrological requirements, expert evaluation, three-dimensional tensiometric platform, preliminary experiments, dynamometric research in sport*

INTRODUCTION

The basis of any research is based on methodological rules including the metrological providing of the methods of research (Batchev (Бачев), 2011); Batchev, Jordanov, Groshev (Бачев, Йорданов, & Грошев), 2013). Each case requires determining of the number of concrete parameters. As it is well known, some of the technical equipment of sport research transforms mechanical values into electrical signals - analogous or digital ones respectively.

That kind of measurements are closely connected with the development of a precise scheme for the connection of transforming devices to the system of apparatuses measuring the mechanical values related to athlete's activities. This presents a serious theoretical and technical problem for specialists to be solved. There are many aspects to the problem, and they are connected with proper understanding of the physical principles of functioning of mechanical value transformers on the one hand, and thorough knowledge of the sport or discipline in the research, on the other. The interdisciplinary character of the required knowledge has determined the forming of a team of specialists in the field of sport and in the measurement of mechanical values. The aim of the research has been formulated in our study on this basis.

The *aim* of our research is to determine the metrological requirements for the necessary equipment – a three-dimensional computerized tensiometric research platform for the development of partial criteria for the evaluation of sport equipment in sports with speed-power manifestation. We have applied the methods of information study; expert evaluation and analysis; modeling; preliminary experiments; theoretical analysis and synthesis.

Research tasks

1. Establishing the metrological requirements for the necessary equipment for measurement and computer processing of indexes characterizing sport technique through measuring the reaction to the support.
2. Approbation and introduction of modern equipment and methodology - a three-dimensional computerized tensiometric platform for studying the technique of sports with speed-power manifestation.
3. Establishing the requirements for software products necessary to carry out control tests on specialized activities in order to study sport technique in the group of sports mentioned above.
4. Creating adequate conditions for the preservation and systematization of research data.

METHODS

We have applied the methods of information study; expert evaluation and analysis; modelling; preliminary experiments; theoretical analysis and synthesis.

RESULTS AND DISCUSSION

The metrological requirements of the characteristics of primary converters are determined on the grounds of theoretical research, and also on the basis of practical experiments and the acquired results. These characteristics include the following: dimensions, sensitivity, operating range, linearity, hysteresis, energy consumption, etc., as well as some specific requirements connected with the unique parameters of the sports person in his/her capacity of the biomechanical system. A good example here is dynamometric research in sport as an objective method for direct measurement, where the above mentioned peculiarities can be clearly discerned.

Research on running events in athletics shows that, contact with the support is minimal in terms of duration, and maximal in terms of value of the muscle effort involved. On the other hand, in gymnastics muscle force is applied on a gymnastics apparatus throughout the entire motor activity. There is also continuous, but cyclic power impact on the support in the scooping intervals of swimming and rowing, but its values cannot be maximal. That is why it is necessary to establish specific metrological requirements for every specific case of research.

It is suggested that, in the direct measurement of dynamic parameters, an experimental measurement system is used including a three-dimensional computerized tensiometric platform for the development of partial criteria for evaluation of sport equipment in sports with speed-power manifestation (Batchev, Groshev, Jordanov(Бачев, Йорданов, & Грошев), 2012).

The metrological requirements for the platform are as follows:

1. The platform is connected to a multi-channel tensiometric amplifier, the outputs of the separate channels are connected to analog-to-digital converters, and through a managing micro-controller - to a monitor and an external printing device;
2. Functioning of the established apparatus system includes the possibility of preliminary general setting and checking;
3. The following calibration is done by means of consecutive and separate loading in all three types of measurements with strictly specific efforts;
4. Received experimental data are stored in arrays of memory where they can be processed mathematically with reference to the aim and tasks of the research;
5. The parameters calculated as a result of the registered dynamic efforts are as follows: gradient of the measured effort; impulse of the applied force; maximal value; minimal value; duration of the power impulse; various indexes and coefficients.

The second result of our research activities is connected with working out the basic algorithm for the software, based on the requirement that information is processed in three stages:

A/ First stage – receiving information from the measurement system. Information from the tensiometric platform could be received in analogous or digital form. The software has to provide receiving of the signal and its preserving in the computer system (Fig.1).

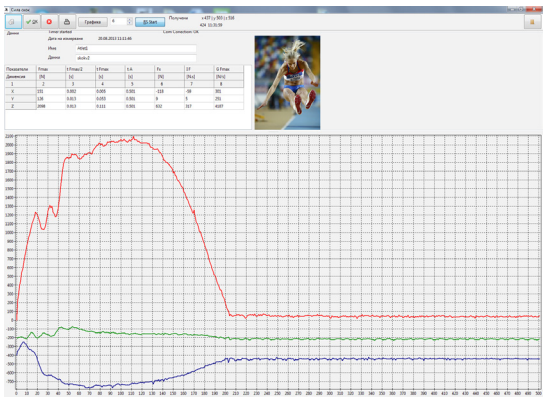

Fig.1.

B/ Second stage – processing information. Amplification and digitalization of the analogue signals together with their parallel analog-to-digital converting, results in the formation of digital words and their transmission to the PC through USB interface. The processing is done by a micro-controller managed by specialized software. Once launched (through hardware) the electronic unit should operate in a fully automatic mode, continuously performing the procedures described above, until it is disconnected (again through hardware). It has to be noted that running time (on the procedure) must be very short - less than a second, as long as the applied effort lasts. For the rest of the time the unit is in standby mode.

C/ Third stage – processing in the PC. Processing the information packages received from the electronic unit is directed toward forming a data base. The launching is done by the panel of the processing program (on the PC display), the system enters a standby mode. That mode could continue for an indefinite period of time, the termination of the procedure is done either by the panel of the program, or after the passage of the active data packages (when performing a motor activity). Termination of the procedure described above leads to the forming of the final array of data.

The dynamometric research could be presented as points with coordinates: the reactive force along the respective axis [N] / time [S], any other parameters could be presented in tables, for example maximal force, impulse of the force, etc. The final results are generated in graphic form and in tables.

In the research of dynamic parameters by means of a three-dimensional tensiometric platform, results are presented graphically and in tables in digital form,

and they are preserved in the permanent memory of the computer. The tables and graphics of the research could be saved and/or printed. All initial settings, including initial zeroing and calibration are done on the panel of the managing program on the PC display. For graphic recordings, the program allows for sections of the graphics along the x-axis to be cut off (time, [sec.]), it is possible for the scale of time in these sections to be altered. The scale of graphics along the y-axis (reactive force) is dynamic, i.e. within each interval (the whole recording or part of it), the program establishes the scale automatically according to the biggest amplitude recorded in the interval, in order to use the swing most rationally.

An additional general requirement to the measurement system is that it must be fully or partially automated. After an authorization by the operator, it is placed on standby mode or the standby is cancelled automatically after the completion of a concrete activity or an intervention by the operator. Research data include the following:

- current date;
- research information;
- name of the subject of the research (the competitor);
- name of the person doing the research.

As *the third result* of our research, a three-dimensional tensiometric platform has been created, according to the metrological requirements described above. It is placed in a massive structure, which is firmly fixed to an even horizontal base in the process of measurement. The platform is attached to the structure by four groups of tensiometric power meters (three in each group). With reference to the established metrological requirements, attention is paid toward ensuring the static determinativeness of the system.

A number of preliminary experiments have been carried out, proving the effectiveness of the measurement system and allowing for future methodological improvements and modelling of the research process to be made, aimed at the development of partial evaluation criteria of sport equipment in sports with speed-power manifestation.

CONCLUSIONS

1. Clear metrological requirements have been established concerning the construction, the preliminary preparation and functioning of the three-dimensional computerized tensiometric platform, used in the development of partial criteria for the evaluation of sport equipment in sports with speed-power manifestation.
2. A software algorithm in three stages has been created - receiving the measurement signal, its processing in the electronic unit, subsequent processing and systematizing database of the quantitative values of concrete dynamic parameters.
3. The three-dimensional computerized tensiometric platform, created according to the metrological requirements, and functioning on the basis of the algorithm used in the experimental research, has proved its effectiveness.

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