Ovidius University Annals, Series Physical Education and Sport / SCIENCE, MOVEMENT AND HEALTH
Vol. XII, ISSUE 2 Supplement 2012, Romania
The journal is indexed in: Ebsco, SPORTDiscus, INDEX COPERNICUS JOURNAL MASTER LIST, DOAJ DIRECTORY OF OPEN ACCES JOURNALS, Caby, Gale Cengace Learning

RESEARCHES REGARDING THE RELATION BETWEEN THE KINEMATIC PARAMETERS MEASURED DURING THE COMPETITION AND THE OBTAINED PERFORMANCE

MIHAI ILIE[1]

Abstract

Purpose. The kinematic analysis represents one of the important issues that are approached in the world high performance track and field technique improvement of the triple jump event for men or women. The purpose of this study was to identify the connection between the kinematic parameters measured during competition and the performance obtained in the competition.

Methods. The research was achieved by using the kinematic analysis of some technical aspects of the male triple jump event and then the results obtained by implementing the Dartfish kinematic analysis software were correlated.

Results. There was a correlation between the kinematic parameters values and the performance obtained in competition regarding the length of the last two running steps, the position of the BMC and the specific angles of the event.

Conclusions. The obtained results may represent means of technical monitoring of the male triple jump event that can help the coaches to achieve the improvement of this event technique.

Key words: kinematic analysis, performance triple jump.

Introduction

Sports performance value represents the result of some continuous, efficient and effective activities, rigorous organized and always tailored to the requirements of performance sports.

Their significance can constitute an instrument for assessing the development of athletes, on the one hand, from the moment of sport beginning until the time of withdrawal, and on the other hand may be formed into a directing tool of the sportive training program content.

"Measurements play a big role in judging the performance: races can be lost by hundredths of a second or field events by fractions of a millimeter.

A photo finish may capture that fractional moment pictorially, and can be used to decide the winner, but it does not help us to compare one athlete's performance with his/her own personal best or with someone else's in previous competition."(http://www.metrologycareers.com/pdf/Measurement-in-Sport.pdf, 26. 03.2012).

Successful performance in any sport is multifactorial. Objective testing of physical, physiological, or skill performance may provide some insight for talent identification and possibly define positional specificity (J.D. Vescovi, T.M. Murray, L.J. Van Heest, 2006).

Robotics, physics, mathematical analysis, imaging, motion capture and computer simulations are some of the latest tools in the quest to improve athletic performance.

Together they are used in the study of biomechanics-the physiological analysis of the interaction of forces and effects of forces on and within the human body. Biomechanics researchers are able to examine each aspect of a movement to enhance performance and to understand the mechanisms of injury (http://www.shlnews.org/?p=89, 26.03.2012).

To produce coordinated movements patterns, the characteristics that define these patterns need to be acquired.

The ability to quantify this coordination or coupling relationship between segments or joints is extremely useful in the analysis of human movement but can be problematic (C. Wilson et. al., 2008).

Variability in movement is particularly important in the many sport skills in which the adaptability of complex motor patterns is necessary within dynamic performance environments (C. Button, K. Davids, W. Schollhorn, 2006).

Motion capture is the preferred analysis method in a wide range of sports applications in research, rehabilitation, physical education and practice.

Physical limitations and movement optimization are of great interest to athletes, coaches, researchers and doctors. In addition to biomechanical studies, motion capture can be used to show how external, psychological factors affect balance, movement ability and performance

[1]Faculty of Physical Education and Sport, University of Pitesti, ROMANIA
Email: ilie112004@yahoo.com
Received 10.05.2012 / Accepted 18.08.2011

Ovidius University Annals, Series Physical Education and Sport / SCIENCE, MOVEMENT AND HEALTH
Vol. XII, ISSUE 2 Supplement 2012, Romania
The journal is indexed in: Ebsco, SPORTDiscus, INDEX COPERNICUS JOURNAL MASTER LIST, DOAJ DIRECTORY OF OPEN ACCES JOURNALS, Caby, Gale Cengace Learning

(http://www.qualisys.com/applications/biomechanics/sport-science/)

Precise measurement of motion has been already incorporated into training routines of numerous professional sport teams in order to improve sportsmen performance (V. Porada, D. Simsik, et al., 2010).

Precise measurement of motion patterns proved itself to be particularly efficient in athletics, where even a small alternation of motion pattern can significantly influence the outcome performance (L. Szerdiová, D. Simšik, Z. Dolná, 2012)

By carrying out this research I considered that by measuring some kinematic parameters during the competition may represent an objective mean of sportive technique monitoring with positive influences on the obtained performance.

The aim of this study was to identify the connection between the kinematic parameters measured during competition and the performance obtained in the competition..

Method

The subjects involved in this research were the finalists of the male triple jump event, participants that participated to the 2012 Indoor Athletics National Championship, senior's category, components of the Athletics National and Olympic Team of the Athletics Romanian Federation.

The experimental approach of this scientific research consisted of:

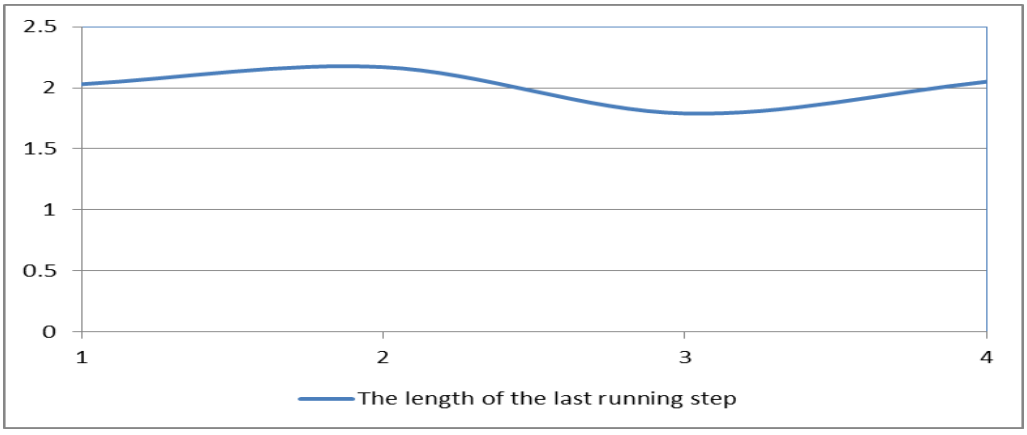
- the establishment of the kinematic parameters aimed in the research (the length of the last running step on the approach, the height of the body mass center in the touch-down contact, the contact angle, the touch-down angle and the take-off angle;
- the positioning of a video camcorder on one side of the touch-down board in order to include in the filming angle the last running steps of the approach, the first touch-down phase as well as it's take-off;
- the recording of the images that capture the technical aspects that were previously presented;
- the processing of these images by using the movement kinematic analysis software called Dartfish ProSuite, v. 5.5, in order to determine the kinematic parameters that were aimed.

The main research methods that were used in order to achieve this scientific research were: references method, kinematic analysis method, case study, etc.

Results

Table 1. The value of the analyzed kinematic parameters and the obtained performance

No	Kinematic parameters	Athletes				Av.	S.D.	C. Var. (%)
		1	2	3	4			
1	The length of the last running step on the approach (m)	2.03	2.17	1.79	2.05	2.01	±0.14	6.86
2	The height of the body mass center in the touch-down contact (m)	0.99	0.93	0.91	0.93	0.94	±0.03	3.19
3	The contact angle (degrees)	75.6	79.1	75.45	78.3	77.11	±1.61	2.09
4	The touch-down angle (degrees)	70.6	59	71.3	60.4	65.33	±5.65	8.65
5	The take-off an (degrees)	14.2	12.5	15.2	12.7	13.65	±1.11	8.13
	Competition performance (m)	**16.97**	**16.16**	**16.08**	**15.59**	-	-	-



Ovidius University Annals, Series Physical Education and Sport / SCIENCE, MOVEMENT AND HEALTH
Vol. XII, ISSUE 2 Supplement 2012, Romania
The journal is indexed in: Ebsco, SPORTDiscus, INDEX COPERNICUS JOURNAL MASTER LIST, DOAJ DIRECTORY OF OPEN ACCES JOURNALS, Caby, Gale Cengace Learning

Figure 1. The dynamic of the last running step on the approach

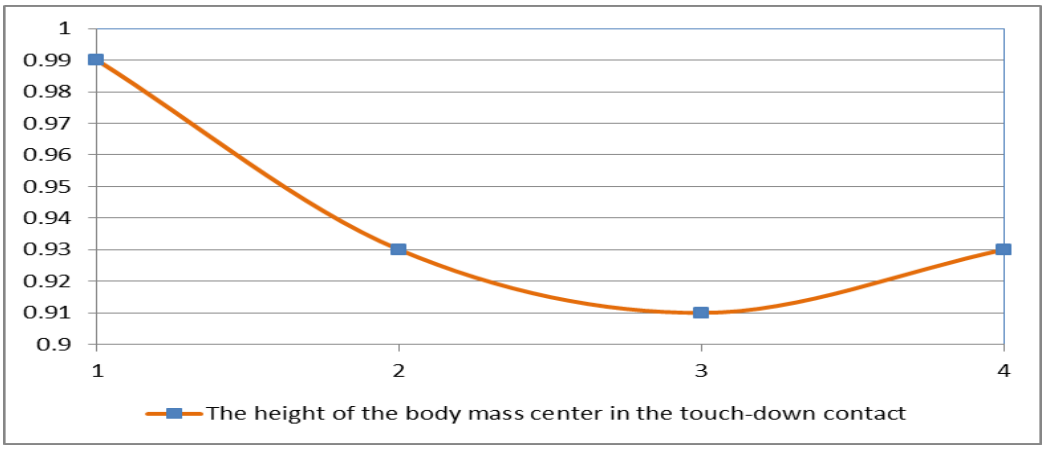


Figure 2. The dynamic of the height of the body mass center in the touch-down contact

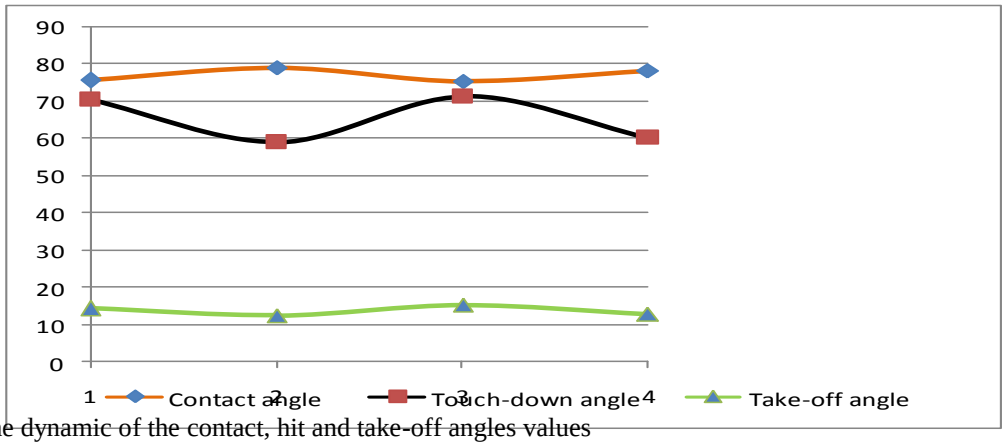


Figure. 3. The dynamic of the contact, hit and take-off angles values

Discussion and conclusion

After the images processing and kinematic parameters determining specific to the male triple jump event that were aimed in this research, we can observe the following aspects:

- regarding length of the last running step on the approach, this recorded an average of 2.01m, with a standard deviation of ± 0.14 m and a variability coefficient of 6.68 % (table 1, figure 1);
- regarding to the height of the body mass center in the touch-down contact, this parameter recorded an average of de 0.94 m, with a standard deviation of ± 0.03 m and a variability coefficient of 3.19 % (table 1, figure 2);
- from the perspective of the angles that are specific fro this track and field event (the contact angle, the touch-down and the take-off angle) they presented the following values (table 1, figure 3):

○ *the contact angle* – recorded an average of 77.11^0, with a standard deviation of $\pm 1.61^0$ and a variability coefficient of 2.09 %;

○ *the touch-down angle* – presented a dynamic having an average of 65.33^0, a standard deviation of $\pm 5.65^0$ and a variability coefficient of 8.65%;

○ *the take-off angle recorded an average of* 13.65^0, with a standard deviation of $\pm 1.11^0$ and a variability coefficient of 8.13 %

The analysis of the data obtained from the research approach emphasizes the fact that the recorded values of the involved athletes' presents an outlined trend comparing with the specialty literature in the case of contact and touch-down angle, while the take-off angle describes a trend between these limits.

Regarding to the height of the body mass center in the touch-down contact, the recorded value is higher than the one stated in the Romanian and foreign literature (I. Mihai, 2009, P. Susanka et. al., 1990), making the mention that one of the factors that can determine this unlike may be the difference of the athletes' height knowing that the

Ovidius University Annals, Series Physical Education and Sport / SCIENCE, MOVEMENT AND HEALTH
Vol. XII, ISSUE 2 Supplement 2012, Romania
The journal is indexed in: Ebsco, SPORTDiscus, INDEX COPERNICUS JOURNAL MASTER LIST, DOAJ DIRECTORY OF OPEN ACCES JOURNALS, Caby, Gale Cengace Learning

position of the body mass center is influences by the height size (I. Mihai, 2011).

By calculating the correlation coefficient (table 2, figure 4) concerning the relation between the values of the kinematic parameters measured and analyzed in this scientific research and the performance obtained in competition it can be emphasized that in four of five correlation situations, the correlation coefficient presents positive values (0.04; 0.82; 0.59; 0.39): the length of the last running step on the approach, the height of the body mass center in the touch-down contact, the touch-down angle and the take-off angle. At the opposite side, the contact angle presents a negative value of the correlation coefficient with the performance obtained in the competition, meaning – 0.55.

Table. 2. Correlation coefficient (r – Pearson)

No	Kinematic parameters	Correlation coefficient
1	The length of the last running step on the approach	0.04
2	The height of the body mass center in the touch-down contact	0.82
3	The contact angle	-0.55
4	The touch-down angle	0.59
5	The take-off angle	0.39

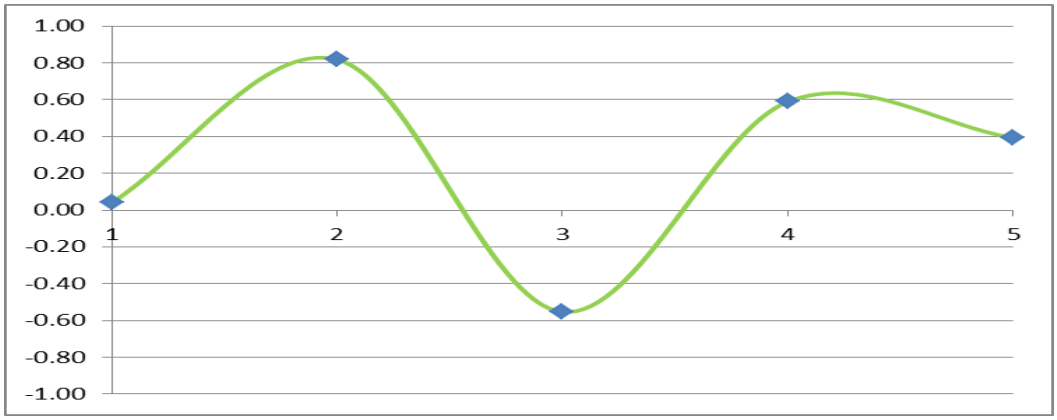


Figure 4. The dynamic of the correlation coefficient (r)

By comparing the values of the correlation coefficient (r), with the ways of its interpretation from the on-line literature (table 3) we can observe that:

- The length of the last running step on the approach presented a correlation coefficient very low, negligible (0.04);
- The height of the body mass center in the touch-down contact presented a very high correlation coefficient (0.82);
- The contact and the touch-down angles presented a high correlation coefficient (-0.55 respective, 0.59);
- The take-off angle presented a moderate correlation coefficient (0.39).

Tabel 3. Interpretation of test value r (M. POPA, f.a.)

Coeficient de corelatie	**Descriptor**
$\leftarrow 0.1$	Very low, negligible, unsubstantial
$0.1 \leftrightarrow 0.3$	Low, minor
$0.3 \leftrightarrow 0.5$	Moderate, medium
$0.5 \leftrightarrow 0.7$	High, major
$0.7 \leftrightarrow 0.9$	Very high
$0.9 \rightarrow$	Almost perfect, describes the relation between two practical indistinct variables.

In conclusion, we can say that, there is a positive correlation between the values of the measured kinematic parameters and the performance obtained in the competition on three from the five indicators respectively, the height of the body mass center in the touch-down contact, the touch-down and the take-off angle. The contact angle presented a negative correlation comparing with the sportive result, and the length of the last running step on the approach indicated a value of the correlation coefficient orientated to a null correlation.

Acknowledgement

This work was supported by CNCSIS – UEFISCDI project number PN II – RU – PD – 167/2010.

References

BUTTON, C., DAVIDS, K., SCHOLLHORN, W., 2006, Coordination profiling of movement systems, K.David, S. Bennet and K. Newell (Eds.), *Movements system variability, Champaign*, IL: Human Kinetics: 133 – 152.

http://www.metrologycareers.com/pdf/Measurement-in-Sport.pdf, 26. 03.2012.

http://www.shlnews.org/?p=89, 26.03.2012.

http://www.qualisys.com/applications/biomechanics/sport-science/, 03.04.2012.

MIHAI, I., 2011, *Researches concerning the analysis of some technical aspects of the male triple jump in competition*, Ovidius University Annals, Series Physical Education and Sport/Science, Movement and Health, vol. XI, Issue 2 Supplement: 380 – 384;

POPA, M., f.a., *The Pearson correlation coefficient* (r), at: **www.mpopa.ro/statistica_licenta/sem_1/st1_11_Pearson_r.pdf, 13.04.2012**

PORADA, V., SIMSIK, D. et al., 2010, *Identification of persons by dynamic walking stereotype*, ISBN 978-80-87236-01-7, 320. Prague.

SZERDIOVÁ, L., SIMŠIK, D, DOLNÁ, Z., 2012, *Assessment of kinematics of sportsmen performing standing long jump in 2 different dynamical conditions*, Metrology and Measurement Systems Journal, Vol. XIX (2012), No. 1, pp. 85–94, Poland

SUSANKA, P., et. al., 1990, *Biomechanical analysis of the triple jump event to the W.C., Rome, 1987*, Methodic Bulletin, no. 2, FRA;

VESCOVI, J.D., MURRAY, T.M., VANHEEST, L.J., 2006, *Positional performance profiling of elite ice hockey players*, Int. Journal of Sports Physiology and Performance, Human Kinetics; 1: 84 – 89;

WILSON, C., SOMPSON, S., VAN EMMERIK, R.E.A., HAMILL, J., 2008, *Coordination variability and skill development in expert triple jumpers*, Sport Biomechanics Journal; 7(1): 2 – 9.