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A CORRELATION APPROACH BETWEEN THE VERTICAL VELOCITY AT THE END OF TAKE-OFF AND JUMPED DISTANCE

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Abstract: *The aim of the present paper is to present a method used to find out one of the influence parameter that determinate the jump distance during the long jump trial. The performances obtained the athletes depends on some parameters as: the length of the run-up, the take off force and time, the mass center angle vs. horizontal direction, the mass centre balancing position during the flight through the air, and the correct landing position. The founded parameter was the vertical velocity of the global mass centre of the athlete at the end of take-off moment.*
Keywords: *biomechanics, long jump, motion analysis, imagine processing*

1. INTRODUCTION

The subject of the present paper is based on the interest in the human ability to set new records in the athletic tests. Biomechanics exercise sets mechanical efficiency of the human body forces and indicate practical methods to increase the yield, depending on the purpose of the training. The long jump is one of the oldest athletic trials.
The technique used by athletes consists of four phases: run-up, take-off, aerial and landing. Thus the performance of a long jumper directly depends on: his/her qualities as sprinter in the first phase, the developed force in legs in the take-off moment, flight and landing.
As it is known, for a great jump distance the athlete must have to the end of the run-up a high horizontal velocity with the take-off placed as close as is possible on the take-off board. After the moment of the take-off the athlete must generate a large vertical velocity combined with a loss minimizing of the horizontal velocity. Another important aspect of the athlete technique is represented by the flight phase when it is necessary to be developed a self-control of the forward rotation produced at the take-off moment. Description of all these phases can be found in different specific papers [1, 2, 3, 4, 5, 6].
In the run-up phase, at the end of the track, the athlete has to obtain a maximum horizontal velocity that is used in the take-off moment. The main target of the take-off is to maximize the flight distance of the athlete body (i.e. the centre of mass) based on both optimum take-off angle and optimum take-off velocity.
In the air, the centre of the mass has a resultant velocity given by two components: a vertical one and a horizontal one. The values of these velocities have to be as large as possible in different moment. Referring to the mass centre, the vertical one is needed to be maximized to stay as much in the air before landing.
The vertical velocity generates a propulsive impulse. A short contact time of the leg in the moment of the take-off and a high force developed in the moment of take-off to produce the push-off, are some of other factors that influence the quality of the long jump.

2. TECHNICAL REQUIREMENTS

The motion was recorded by a high speed camera (AOS X - PRI) done with a resolution of 800x600 pixels at 500 frames/s. On each jumper body there were attached coloured markers, the points of attachments were established considering the main points of a mechanical equivalent model of the body and using the suggestions given by the trainers. The markers were placed on the bodies on the same side with the video camera.
The video camera was installed in the lateral direction, on a perpendicular direction on the jumpers at a distance of 5.20 meters from the jump path and was mainly focusing on the take-off point. In the same time the considered position offered the posibility to obtain images in the sagittal plane of the athlete during performing of the long jump (Fig.1).
Video camera was attached to a Laptop and it was used a specialised soft for recording.

Figure 1: Camera AOS X –PRI and recording data system

Four long jump athletes with high level competition performances were considered for the present study: two females and two males (different jump techniques) and they were members of the Romania National Athletic Team. The tests were done during the training in the summer camp conducted by Athletics Squad in the Romanian National Sports Complex (Poiana Brasov) for a period of two weeks. In Fig.2 it is presented the trajectory of the jumper highlight by a selected marker.

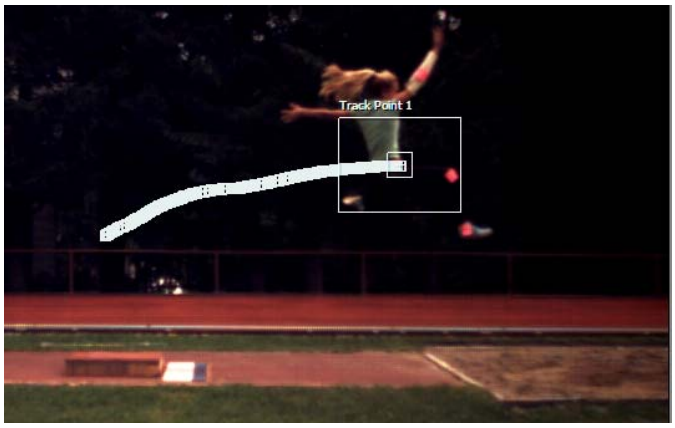

Figure 2: The trajectory of jumper mass

Points which define the trajectory are copied to the Excel tables which contains Y coordinate of the markers of athletes during motion. Afterwards we used MATLAB program for interpolating values of Y (Fig. 3).

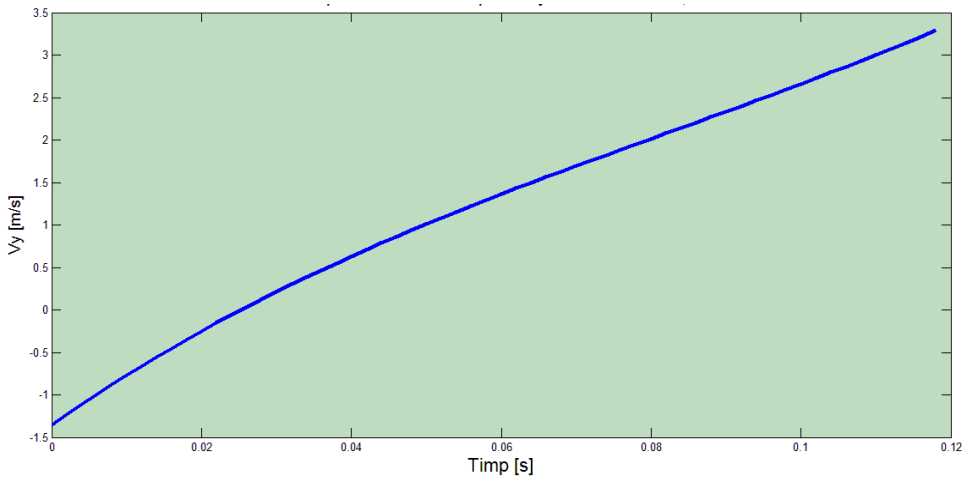

Figure 3: Vertical velocity

3. RESULTS

It is presented the study done on one of the four analysed athletes, with best values of the parameters considered in the take-off moment. The recorded data are presented in Table 1.

Table 1: Vertical velocity and jump length

No. Jump	Vy component [m/s]	Jump length [m]
1	3.332	5.27
2	3.391	5.36
3	3.601	5.39
4	4.294	6.59
5	4.262	6.43
6	4.197	6.40
7	4.023	6.34
8	3.876	6.22
9	4.026	6.09
10	2.851	5.10

3. CONCLUSION

The long jump consists of four phases, each one very important. One of these phases is the take-off. As was presented above there are done a lot of studies about this moment being analysed important parameter: vertical velocity of the global mass centre of the athlete at the end of take-off moment. Long jump performance is mainly determined by the athlete ‘s vertical velocity at the end of take-off.

REFERENCES

[1] J. G. Hay, J. A. Miller, R. W. Canterna: The techniques of elite male long jumpers, Journal of Biomechanics, Vol. 19, (1986), pp. 855–66.

[2] J. G. Hay, H. Nohara: Techniques used by elite long jumpers in preparation for takeoff, Journal of Biomechanics, Vol. 23 (1990), pp. 229–39.

[3] J. G. Hay, T. J. Koh: Evaluating the approach in the horizontal jumps, International Journal of Sport Biomechanics, Vol. 4 (1988), pp. 372–92.

[4] A. Lees., N. Fowler, D. Derby: A biomechanical analysis of the last stride, touch-down and take-off characteristics of the women’s long jump, Journal of Sports Sciences, Vol. 11 (1993), pp. 303–14.

[5] A. Lees, P. Graham-Smith, N. Fowler: A biomechanical analysis of the last stride, touchdown, and takeoff characteristics of the men’s long jump, Journal of Applied Biomechanics, Vol. 10 (1994), pp. 61–78.

[6] A. Seyfarth, R. Blickhan, J. L. Van Leeuwen: Optimum take-off techniques and muscle design for long jump, The Journal of Experimental Biology, Vol. 203 (2000), pp. 741-750.