3rd International Conference
"Research & Innovation in Engineering "
COMAT 2014
16-17 October 2014, Braşov, Romania

A METHOD FOR DETERMINATE THE RUN-UP VELOCITY OF THE LONG JUMP

M. V. Guiman[1], M. Mihălcică[2], M. V. Munteanu[3],
[1] „Transilvania" University, Brasov, ROMANIA, violeta.guiman@unitbv.ro
[2] „Transilvania" University, Brasov, ROMANIA, mircea.mihalcica@unitbv.ro
[3] „Transilvania" University, Brasov, ROMANIA, v.munteanu@unitbv.ro

Abstract: *The purpose of the present study was to describe a method for determinate the run-up velocity of the long jump approach. Four long jumpers' long jump performance participated in the study. The run-up motions of the participants were captured with a high-speed digital camera (500 fps) for two-dimensional motion analysis. The optimal length of the run-up for any athlete it's determinate by his ability to sprint and is directly proportional to the increasing velocity.*
Keywords: *motion analysis, long jump, run-up velocity.*

1. INTRODUCTION

Long jump is characterized by four important phases: Run-up, Take off, Flight through the air and Landing. Each of these shall be properly performed to making a large jump distances. To show up well, a long jumper must be a fast sprinter, have strong legs for jumping, and maintain proper balance during flight and landing phase. Run-up has two purposes: producing the maximum velocity and preparation for the take-off.
To produce the maximum velocity, the athlete must adapt the length of run-up to sprinting ability. In 1983 Popov has determined a „correct length of run-up" [1], only for the male athletes, based on times achieved by the athletes in sprint race:

Table 1: Correct length of run-up

Times for 30 m (s)	Times for 100 m (s)	length of run-up (number of steps)
4,7	13,0	12
4,5	12,5	14
4,3	12,0	16
4,1	11,5	18
3,9	10,9	20
3,7	10,4	22

The relationship between run-up velocity and distance jumped in long jump it is highly significant, but according as force and other qualities develop, the technique of the long jump became more important than running velocity. Several experimental investigations of the run-up velocity in the athletic event of long jumping can be found in the literature, in which there are ecuations about run-up velocity and distance jumped:

- Tiupa, Aleshinsky, Primakov, and Pereverzev (1982)[3]

$$D = 0{,}021v^2 + 0{,}725v - 1{,}65 \quad (1)$$

Where D - distance jumped (m) and v - run-up velocity (m/s)

- Siluyanov and Maximov (1977)[2]

$D = 0{,}83v$ Beamon

$D = 0{,}79v$ Ter-Ovanesian

In conclusion it is important to measure properly run-up velocity.

2. TECHNICAL REQUIREMENTS

Motion capture was done with AOS high speed camera (Figure 1), type X-PRI color, operating at a frequency of 500 fields/sec. Video camera was placed in the side view perpendicular to the runway, at a distance of 10 m from the take-off board, recorded the jumps in the frontal plane. A global reference frame was defined with the x axis parallel to the runway and the y axis was vertical. Each athlete had markers attached to the main joints: knee, ankle, hip, elbow, shoulder.

Figure 1: AOS high speed camera

After we have the video materials, we analyze them with Adobe After Effects and we obtain a trajectory of each marker, see figure 2.

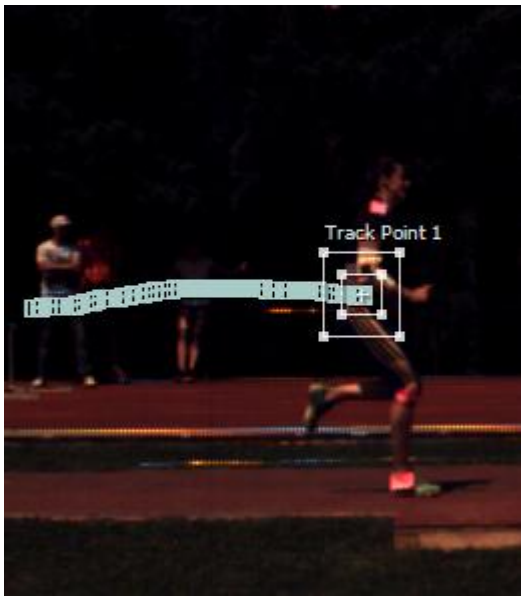

Figure 2: Trajectory of hip of mass marker in Adobe After Effects

Points which define the trajectory are copied to the Excel tables which contains X and Y coordinates of the markers of athletes during motion.
Afterwards we used MATLAB program for interpolating values of X with respect to time and first coefficients polynomial of degree one:

$f(x) = p1*x + p2$

it is the velocity, in this case

$p1 = 8.443$ [m/s]

In the following we present the figure of curve fitting interpolation

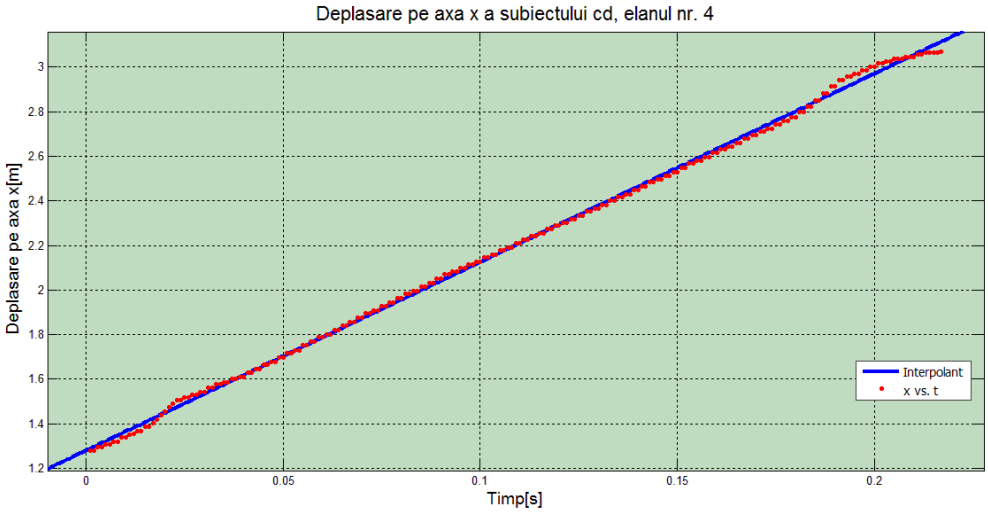

Figure 2: Trajectory Curve fitting interpolation of the hip marker

3. CONCLUSION

Long jump performance is mainly determined by the athlete‘s run-up velocity. The method presented above, for determinate the run-up velocity of the long jump is accurate and accessible. It can be successfully used for all persons who analyzes human movements, especially in sports.

REFERENCES

References should be indicated in the text using consecutive numbers in square brackets, e. g. [1]. In the bibliography they should be cited including the title of the paper:

[1] Popov, V. B., The long jump run-up, Track Technique, 85, 2708-2709, 1983.
[2] Siluyanov, V., Maximov, R., Speed and strength in the long jump, Legkaia Athletika 10:18, Translated by Michael Yessis and reported in Yessis Review of Soviet Physical Education and Sports 13: 71-73, 1977.
[3] Tiupa, V.V., Aleshinsky, S.I., Primakov, I.N., & Pereverzev, A.P., The biomechanics of the movement of the body’s general centre of mass during the long jump. Theoria i Praktika Fizicheskoi Kulturi, 5, 21-32, 1982.