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BIOMECHANICS RESEARCH IN THE 2022 EUROPEAN THROWING CUP LEIRIA – PORTUGAL

EUROPEAN THROWING CUP

Leiria 2022/23/24

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JUVENTUDE VIDIGALENSE POUSOS - LEIRIA

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BIOMECHANICS RESEARCH IN THE 2022 EUROPEAN THROWING CUP, LEIRIA – PORTUGAL

Abstract

Several technical and research studies were developed in throwing events in the past years. This project has the purpose of characterize biomechanically each elite thrower in their best attempt. The aim is to help athletes and coaches to improve technique components, and consequently, their performance. The subjects will be the participating athletes in the competition. As condition, the athletes who want to participate will sign a consent form approved by the Ethical Council of Instituto Politécnico de Leiria (Polytechnic of Leiria) that was made following the agreement of the Helsinki Declaration. We will use two cameras to capture the motion of the athlete, one in the frontal plan and one in the sagittal plan. The DLT will be applied to transform the digital coordinates in metric coordinates. The project will characterize biomechanical parameters such as velocity, angle and height release, the implement path, and the linear and angular positions of the body segments throughout throwing.

Introduction

Since 1987, and after many biomechanical projects, numerous reports have been made and presented during throwing events on great competitions of Track and Field, providing technical information to coaches (Bennett, Walker, Bissas, & Merlino, 2017; Brüggemann, Koszewski, & Müller, 1997; Brüggemann et al., 1987; Mendoza, Nixdor, Isele, & Günther, 2009; Schaa W, 2010; Schade & Brüggemann, 2006). In order to help the specialist coaches understand the technical details, these experts were , providing information to improve their way of teaching the technique, specially to young athletes (Susanka, 1986). In the 2009 World Championship, Badura (2010) two cameras were used to perform a 3D kinematic analysis and to characterize the involved athletes in discus throwing competitions and analysed the discus release velocity and angle, the displacement and velocity of body segments, as well as the temporal characterization on different phases of the throwing discus (Badura, 2010). In an unpublished work in 2018, the Federação Portuguesa de Atletismo (Portuguese Athletics Federation), with the cooperation of the European Athletics, the Escola Superior de Tecnologia e

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Gestão do Instituto Politécnico de Leiria (Technology and Management School of Polytechnic of Leiria), and the Juventude Vidigalense Club implemented a biomechanical project to characterize the athletes, providing detailed information to athletes and coaches that participated in the study. There were research works with elite throwers athletes (Leigh, Gross, Li, & Yu, 2008; Liu, Leigh, & Yu, 2010; Viitasalo, Mononen, & Norvapalo, 2003). Viitasalo et al. (2003) analysed the release parameters of elite javelin throwers and identified that the release velocity was highly associated with the performance of javelin athletes. Liu et al. (2010) examined the sequences of the beginnings of the lower and upper extremity segment and joint angular motions of elite javelin throwers. The study concludes that the athletes do not follow a proximal-to-distal sequence as expected in literature. Leigh et al (2008) determined the correlation between the release velocity and the release angle and between the aerodynamics distance and the release angle, and the optimal release angle in discus throwers, it was also calculated. The authors showed that the release velocity and the aerodynamic distance are correlated with the release angle in the discus thrower, and the optimal release angle is different for each discus throwers (Leigh et al., 2008). This project has the purpose to characterize biomechanically each elite thrower in their best attempt. We aim to help athletes and coaches to improve training quality, and consequently, their athlete's performance.

Methods

Subjects

The study will have as subjects the throwers that will participate in European Throwing's Cup 2022 that consent to participate. They will have to sign the Consent Form approved by the Ethical Council of the Polytechnic of Leiria which was made attending the ethical rights of the Helsinki Declaration.

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Material

Discus, Shot Put

The biomechanical parameters will be obtained through video. The video recording will be performed with two video cameras (Panasonic Lumix ZR200) with a frame rate of 100 frames/s (100Hz), at a resolution of 1280 x 720 pixels.

The synchronization will be performed through the first ground contact after the flight phase of the motion.

Hammer

Video recording is carried out with two video cameras (Canon XH G5/6S) identical in construction and capable of being genlocked at an image frequency of 25 frames/s (50 fields/s) at a resolution of 720 x 576 pixels (16:9 format). Depending on the lightness, exposure times of the single frames are adjusted 1/500sec, using an electronic shutter to avoid in-motion blur.

Both video cameras will be internally initially synchronized, using the Genlock procedures so that the single frames of both cameras will be exposed at the same point in time.

Javelin

The biomechanical parameters will be obtained through video. The video recording will be realized with two video cameras (Casio FZ1000 and Casio FZ200) with a frame rate of 120 frames/s at a resolution of 640 x 480 pixels.

The synchronization will be done with first ground contact after the flight phase of the motion.

Data Collection

The cameras will be placed in the frontal plane (posterior side) and the sagittal plane (right side). Both cameras will be positioned to capture the thrower, and the discus (Figure 1), hammer (Figure 3), javelin (Figure 6) and shot put (Figure 7). Both cameras will have attached a tripod with an angle of 90 degrees

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to each one. The placement of the cameras can be slightly changed, the cameraman in each camera (discus, javelin and shot put) and the computer (hammer) can be changed facilitate the coaches' view.

Calibration

We will apply direct linear transformation method to calculate three-dimensional spatial coordinates (Abdel-Aziz, Karara, & Hauck, 2015). Before the competition, we will put on into the throwing circle a calibration volume , to Discus Throw (Figure 2), Hammer Throw (Figure 4), and Shot Put (Figure 8). To the Javelin Throw that will put on into the track (Figure 5).

Discus

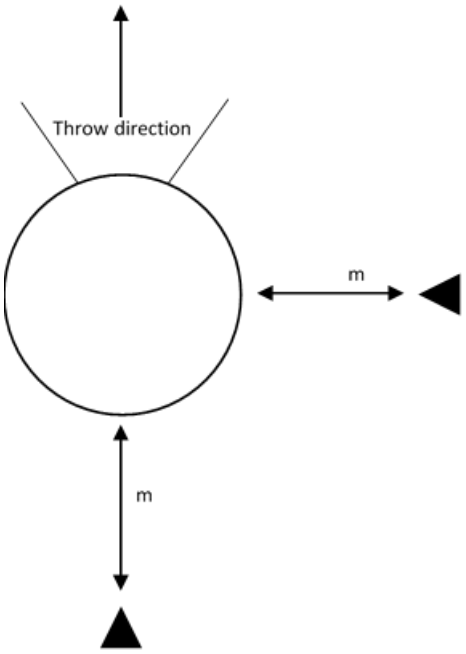

Figure 1 - Experimental setup in discus throwing

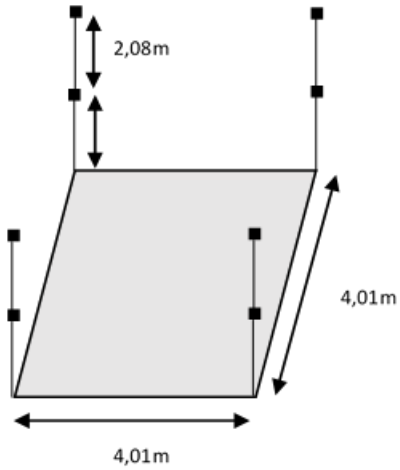

Figure 2 - Dimensions of the calibration volume in discus throwing

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Hammer

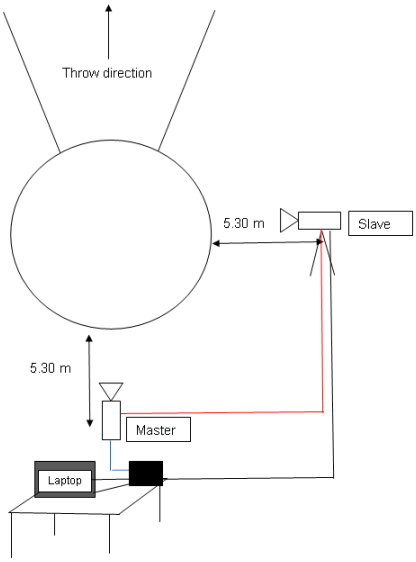

Figure 3 - Experimental setup in hammer throwing

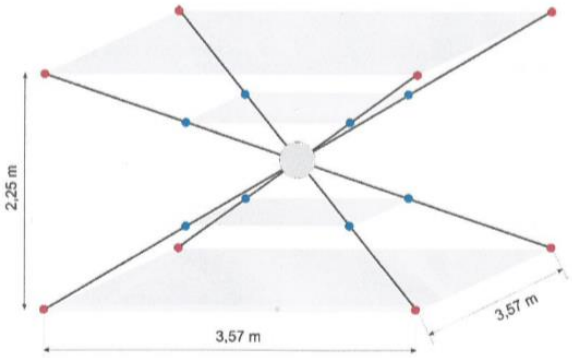

Figure 4 - Dimensions of the calibration volume in hammer throwing

Javelin

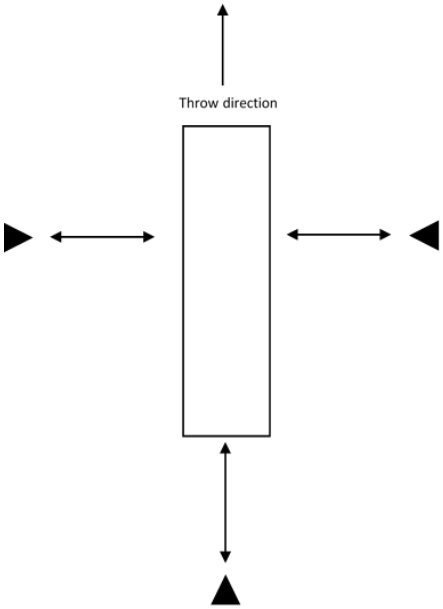

Figure 6 - Experimental setup in javelin throwing

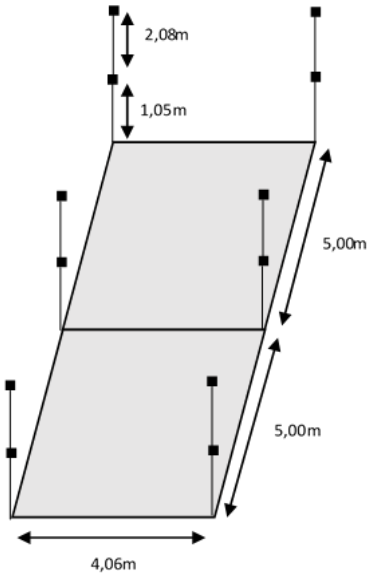

Figure 5 - Dimensions of the calibration volume in javelin throwing

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Shot Put

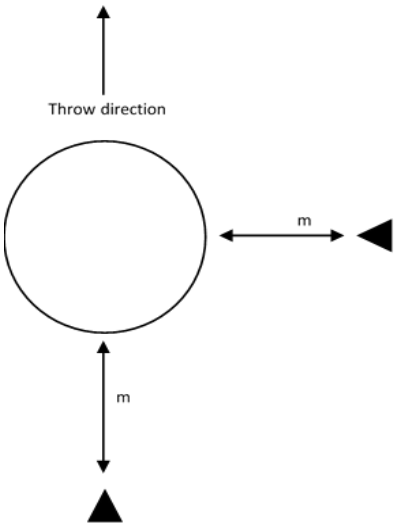

Figure 7 - Experimental setup in shot put throwing

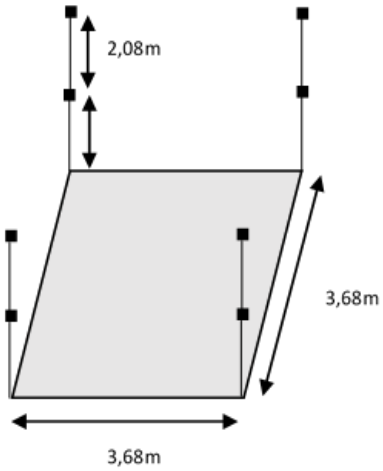

Figure 8 - Dimensions of the calibration volume in shot put throwing

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Expect Results

Parameters analysed			
Discus Throw	**Hammer Throw**	**Javelin Throw**	**Shot Put**
Release velocity			
Release angle			
Release height			
Total duration			
Total Time			
Attack angle	Velocity to the Low point 0	Attitude angle	Duration first single support
Aerodynamic quality	Path of Hammer	Attack angle	Duration Flight phase
Duration first single support	Duration single and double support	Yaw angle	Duration second single support
Duration Flight phase	Radius of curvature	Length of impulse stride	Path of shot put
Duration second single support	Angular velocity	Length of delivery stride	Shot put velocity
Path of Discus	Low point	Pull Distance	Segments positions
Discus velocity	High point	Duration of first front leg	
Segments positions	Hammer velocity	Duration Flight Phase	
	Velocity of centre of body	Duration of rear leg	
	Height of centre of body	Duration of power position	
	Segments positions	Path of javelin	
		Javelin velocity	
		Javelin acceleration	

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Collaboration

This biomechanical project is proposed by the Portuguese Athletics Federation and it will have the collaboration with the Polytechnic of Leiria, Portugal, the Juventude Vidigalense Club from Leiria, Portugal, and the Institute for Applied Scientific Training (IAT) from Leipzig, Germany.

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