28th ECSS Anniversary Congress, Paris/France, 4-7 July 2023

Clustering technical approaches of world class pole vaulters

Cassirame, J., Eustache, E., Sanchez, H., Czingon, H., Homo, S., Frère, J.

1University of Franche–Comte, C3S–UR 4660, Besançon, France 2EA 7507, LPMS, 51100 Reims, France 3Mtraining, R&D division, 25480 Ecole Valentin, France

4 University of Neuchâtel, institut de statistique, Switzerland

5 French Athletics Federation, Paris, France

6 University Grenoble Alpes, GIPSA-Lab, 38000 Grenoble, France

INTRODUCTION:

Pole vault performance has been mainly biomechanically investigated to point out performance determinants [1]. Several key parameters were highlighted such as speed, grip, size of athletes or take-off (TK) angle. From this, many coaches and scientists published studies describing ideal technical approaches of pole vaulting for performance [2]. Today, observations of top vaulters raise questions about the classical technical model that is well-documented. The goal of this study was to identify potential technical profiles using actual measurements taken during official competitions and to examine these profiles from athlete's characteristics and mechanical perspective.

METHODS:

Data were collected during more than 80 official competitions with same experimental setup. Best jump from 98 men with personal best between 5.10 and 6.21 m were analyzed. Spatiotemporal parameters and horizontal speed were collected during the run-up using Optojump Next system (Microgate, Italy) synchronized with radar gun (Applied Concept, USA). Kinematic (pole bending) and dynamic (mechanical energy gain) analyses were done by means of 2-dimensional video analysis on sagittal plan (100 Hz, Panasonic HC-V770, Japan). Pole vaulters were divided into an optimal number of non-overlapping subgroups using the k-means clustering method based on two technical parameters allowing identification of technical styles independent of morphology or level: TK angle and Under (horizontal distance between TK foot and upper hand). RESULTS:

K-means method pointed out 4 clusters with distinct behaviors. Cluster 1 (C1) was composed of athletes with high to moderate Under with higher TK angle (over 12.5 °). C2 was composed of athletes with lower Under-values and higher TK angle. C3 included athletes with high to moderate Under and lower TK angle. Finally, athletes of C4 had low Under-values with the lowest TK angle. C4 was composed with smaller athletes, running with the smallest contact time, and an increased the last stride while others tended to reduce this one. C4 athletes performed with higher TK distance and produced the biggest pole bending ratio. C2 athletes performed with stiffer pole, higher grip distance and produced the smallest pole bending. C1 and C3 produced their performance using smaller grip and TK distance than another clusters. We did not identify any differences in speed or energy gain between clusters.

CONCLUSION:

This study pointed out that different pole vault styles can be highlighted at world class level based on technical parameters. We observed that each cluster produces performances with similar speed and energy net gain level as input but had various behaviors when interacting with the pole (TK phase, pole bending and trajectory). Therefore, it is of interest to describe more accurately these technical approaches for teaching this discipline and improving coaching process.

1. Frère et al., Sports Biomech, 2010

2. Petrov, New Stud Athl, 2004

Topic: Training and Testing

Presentation

European Database of Sport Science (EDSS)

Poster

Supported by SporTools GmbH

