THE APPLICATION OF THE BIOMECHANICS MODELS FOR THE CONTROL OF THE "IMPROVEMENT TARGETS" IN 110m MEN'S HURDLES

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INTRODUCTION

This study falls into the general theme of "Diagnosis of athletic performance". Diagnosis in this case, does not refer to the complexity of athletic performance but only to those features of performance that refer to the analysis of the technique.

The method of diagnosis refers to the method of the model and specifically to the Deterministic and Indeterministic models. The object of this study is:

a. The construction of a model for the calculation of the degree of impact of certain biomechanic characteristics on the performance of hurdle clearance.

b. The use of the model for the estimate of the degree of influence of the biomechanic features on the hurdle clearance performance and the selection of the direction characteristics.

c. Direction of the most important technique traits.

d. Evaluation of the effectiveness of the direction methods with in the scope of the technique training and with regard to the criteria of the models' method.

METHODOLOGY

A Model is described as "every imaginary or real system that depicts or reproduces the object of research. that can be replac-ed by it in such a way that it can studied through it, forwarding thus new information concerning the object" (Kedzior et al. 1988).

"The Biomechanic models of athletic movement Y present reduced or real descriptions of movement having as an ulterior purpose to define, as possible as it can be, its differentiation, in relation to the modifications of the biomechanical characteristics (xi)" (Ballreich, 1980).

The steps were:

a.) Specification of the models"s target

We defined two traits as "criteria of performance" or "improvement targets" (Fig. 1,2):

1. The maximum height (H) of the center of mass (CM) and

2. The horizontal take-off velocity ([illegible]) at the end of the support phase of landing.

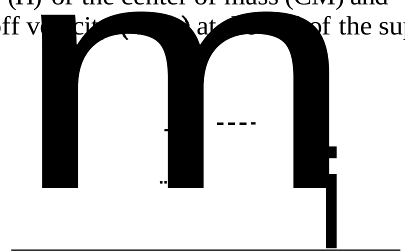

Figure 1: Maximum height of CM (H)

Our target is a low clearance of the hurdle and a quick transition from not circular movement (hurdle) to circular movement (race).

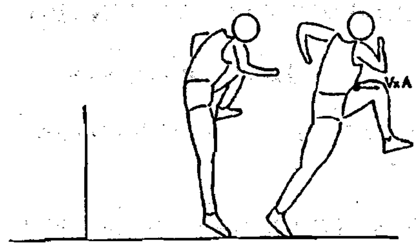

Figure 2: Horizontal take-off velocity of CM (VxA)

b.) Description and **analysis** of the system

A mechanical simplification of the human body can be achieved with the point mass model, that is, the centre of the body gravity "which moves according to the laws of mechanics, as if the whole mass of the system were attached to it, and all the external forces affecting the system, were applied to this point (CM)" **(Baumann** 1983).

c.) Construction of the model, creation of the computing system

For a better examination of the maximum height of the CM (H), we divide the height (H) into two separate characteristics (Fig. 3 & **4),** which are: the take-off height **(H_1)** and the flight height **(H_2).**

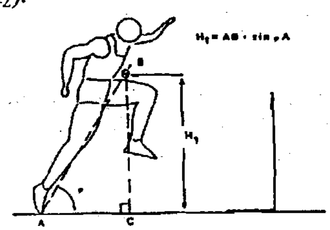

Figure 3: Model for the description of the take-off height (H_1)

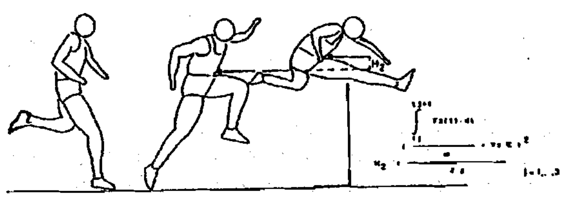

Figure 4: Model for the description of the flight height (H_2)

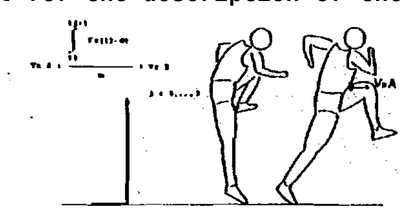

Figure 5: Model for the description of the horizontal take-off velocity of the CM (VxA)

d.) Evaluation of the function of **thr** computing programme, comparison of its results with the original

To examine the model and, as primary data, we used the rates of 16 hurdlers during the third hurdle clearance in a **45m** hurdle race

Concerning the **H_1,** the following data have resulted:

n = 16

x = **1.19m** (observed rates)
H_1 = **1.19m** (estimated rates)
Error **< 0.01m**

Concerning the H_2, the following data have resulted:

n = 16
x = **0.23m** (observed rates)
H_2 = **0.23m** (estimated rates)
Error **< 0.01m**

Concerning the VxA, the following data have resulted:

n = 16
x = **7.78m/s** (observed rates)
VxA = **7.78m/s** (estimated rates)
Error **< 0.01m/s**

e. Improvement of the model

In the Deterministic model there is the possibility that the correlations that possibly exist among the contingent **kinematic** traits of the model are not considered, which in turn, will lead to an arbitrary differentiation.

Because of this, the need for the construction of an Indeterministic model is brought forward, of a model based on the **whole** on primary data.

In the first phase the procedures for the definition of the biomechanical characteristics affecting motion are completed considering the Indeterministic model and according to the mathematical model of the Correlation analysis.

In the next stage, the independent movement features are "linked together", using the mathematical model of multiple Regression analysis (Fig. 7).

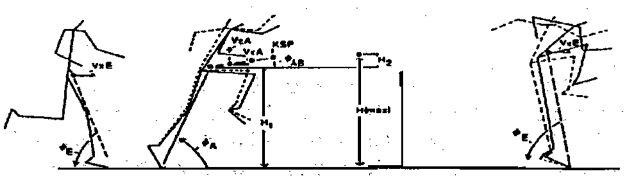

Figure 7: Kinematic characteristics for the direction of the technique training (PAPAWPOULOS 1990. 135)

The method of the models (Deterministic and Indeterministic) has presented five different **kinematic** characteristics, which we have used to the' direction of the technique training (Fig. 7).

RESULTS AND DISCUSSION

In table 1, we can see the **modification of** selected **kinematic** characteristics before and after the technique training.

Table 1: Modification of selected kinematic characteristics during the hurdle clearance phase in the experimental group (before and after the training)

			n=8 before training		n=8 after training	
Variables	Symbol	Unit	M	SD	M	SD
Performance in hurdles	L_H	sec	6.82	0.23	6.62	0.22

BEFORE THE HURDLE							
Take-off angle	φA	Grad	6.7	2.2	65	2.2	
Flight angle	φAB	Grad		16	2	14	1.2
Vertical modification in T3	$\Delta Vz3$	m/s		1.27	0.20	1.10	0.11
Flight time	t_F	sec		0.41	0.03	0.37	0.03
Maximum height of CM	H	m		1.42	0.06	1.38	0.03
Take-off height	H_1	m		1.19	0.04	1.18	0.04
Flight height	H_2	m		0.23	0.05	0.19	0.02
Horizontal modification of velocity	ΔVxS	m/s		-0.44	0.04	-0.30	0.03
AFTER THE HURDLE							
Horizontal take-off velocity	VxA	m/s		7.77	0.32	7.97	0.26
Support time	t_G	sec		0.11	0.01	0.10	0.01
Landing angle	φE	Grad		85	2.6	87	2.7

The contingent mechanical characteristics chosen, were given to the athletes as a direction. A correlation between the results of the models method and training cannot be defined in advance, unless it is preceded by an evaluation of performance.

The solution every athlete chooses to improve his technique, mainly relies both on his/her biological "prescriptions" as well as on the mechanical determinism governing motion.

The trainer's duty is to decide on the ideal synthesis of the existing prerequisities.

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