INVESTIGATION OF THE CHANGES OF THE MASS MOMENTS OF INERTIA DURING A DOUBLE STEP OF RUNNING

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INTRODUCTION: A new method for the investigation of athletes' motion takes into consideration the changes of the principal moments of inertia and their directions during the interval of the motion, because these characterize both the changes and the loss of energy. This paper investigates the motion of a runner. The applied model is a refined Hanavan model [1], representing the human body with 16 simple geometric solids determined by the spatial co-ordinates of 20 key points.

METHODS AND PROCEDURES: The records were made by The Biomechanics Department of the Hungarian University of Physical Education with several video cameras. For the digitalization of the frames the APAS (Ariel Performance Analysis System) was used.
The data of the digitized key points were analyzed by the system (MAS = Motion Analyzing System), developed for PC at the Department of Applied Mechanics of the Technical University of Budapest.
Fig. 1 shows 11 different phases of the motion in the same picture. The time interval between the first and last phase is 0.9 sec. During the analysis 46 frames were digitized with a time-interval of 0.02 sec. This paper investigates the changes of the eigensystem for the mass moments of inertia of the whole human body with respect to the center of mass during the interval of the motion.

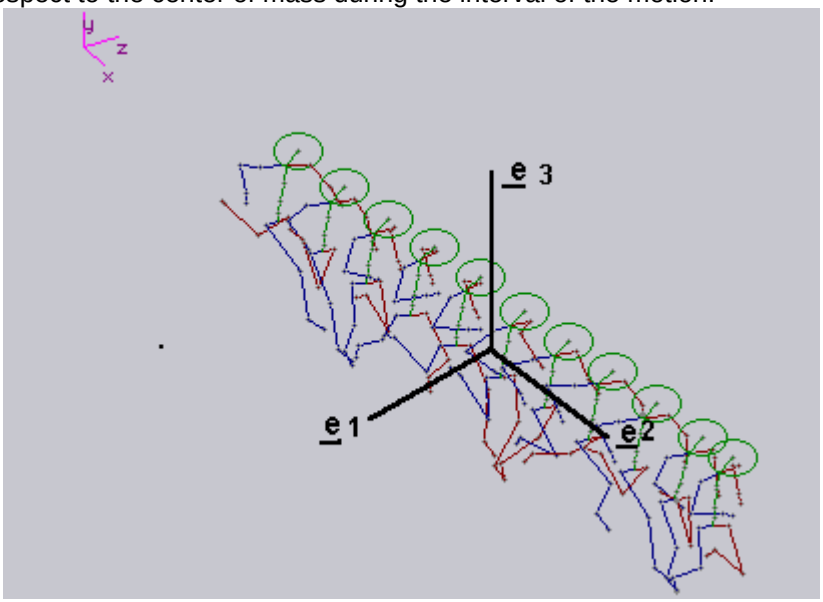

Fig. 1.

RESULTS: In the following figures (Fig. 2 -Fig. 13) the changes of the values of the principal moments of inertia (I_1, I_2 and I_3) and the coordinates of their eigenvectors are shown during a double step of running.

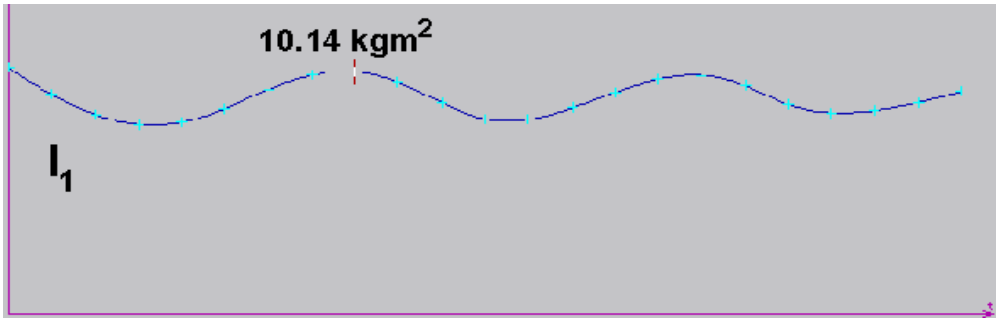

Fig. 2.: The changes of the value of the first principal moment of inertia

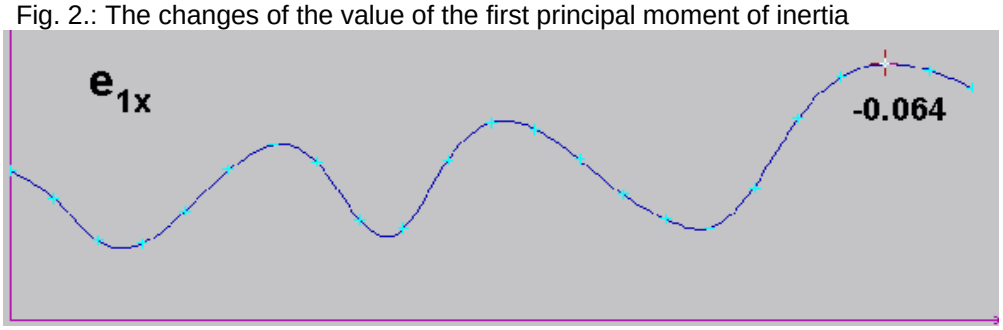

Fig. 3.: The changes of the x coordinate of the first eigenvector

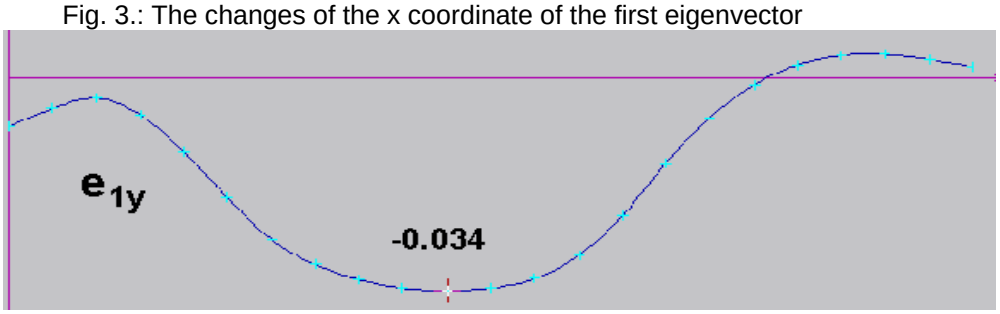

Fig. 4.: The changes of the y coordinate of the first eigenvector

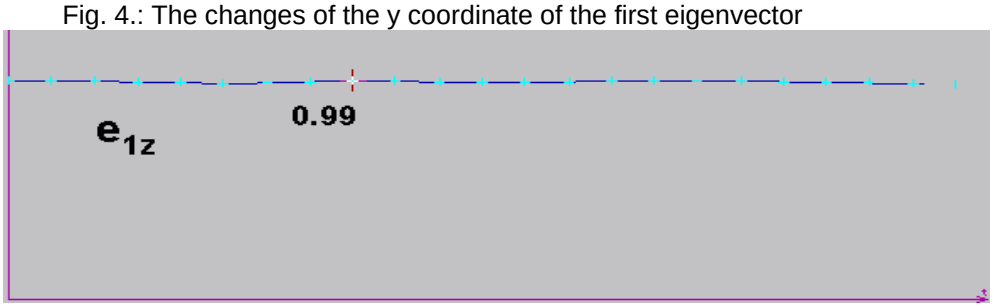

Fig. 5.: The changes of the z coordinate of the first eigenvector

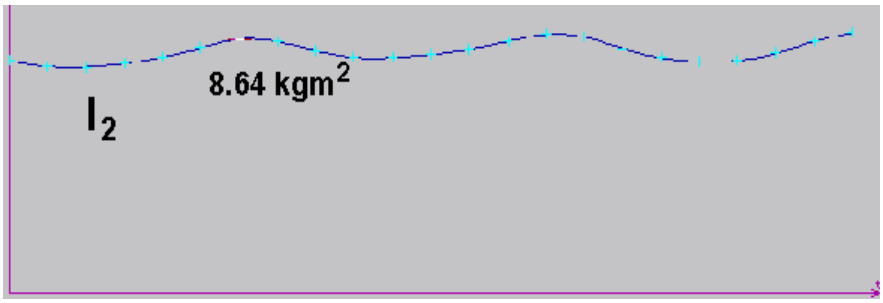

Fig. 6.: The changes of the value of the second principal moment of inertia

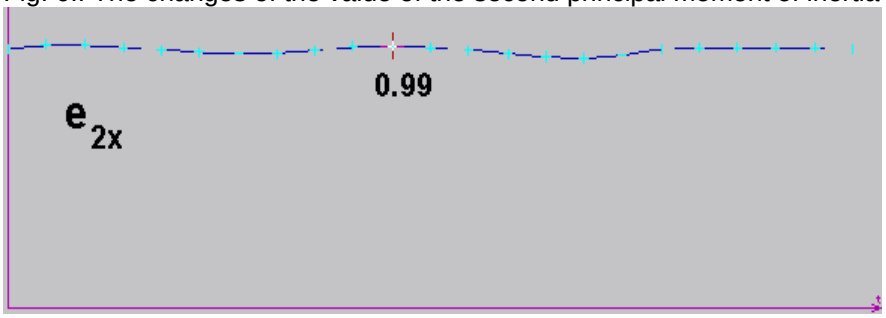

Fig.7.: The changes of the x coordinate of the second eigenvector

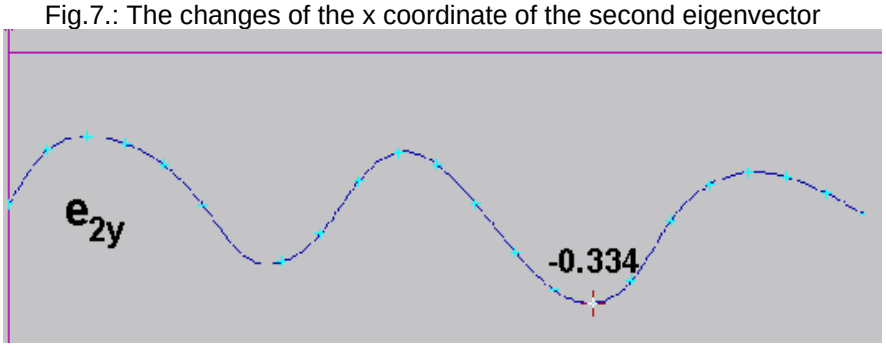

Fig. 8.: The changes of the y coordinate of the second eigenvector

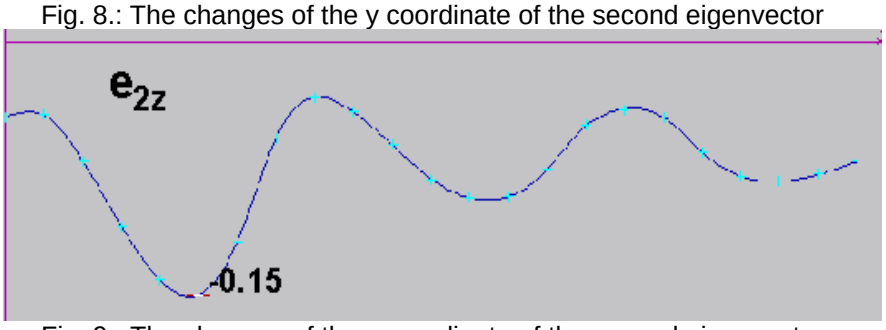

Fig. 9.: The changes of the z coordinate of the second eigenvector

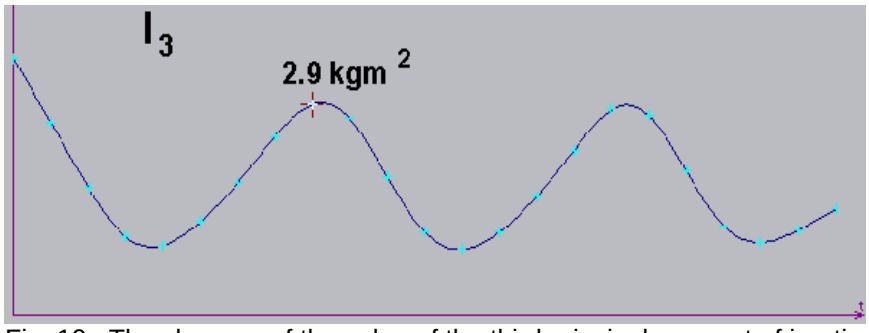

Fig. 10.: The changes of the value of the third principal moment of inertia

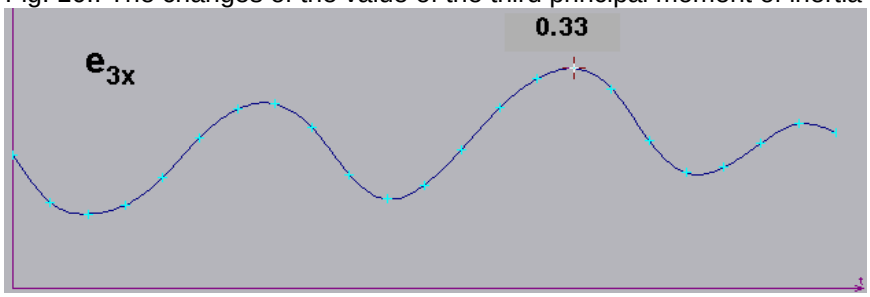

Fig. 11.: The changes of the x coordinate of the third eigenvector

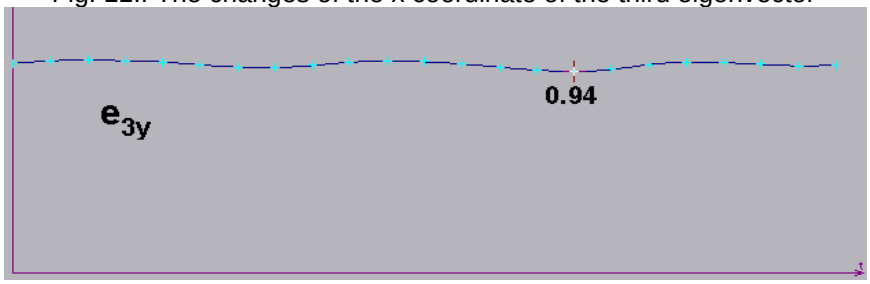

Fig. 12.: The changes of the y coordinate of the third eigenvector

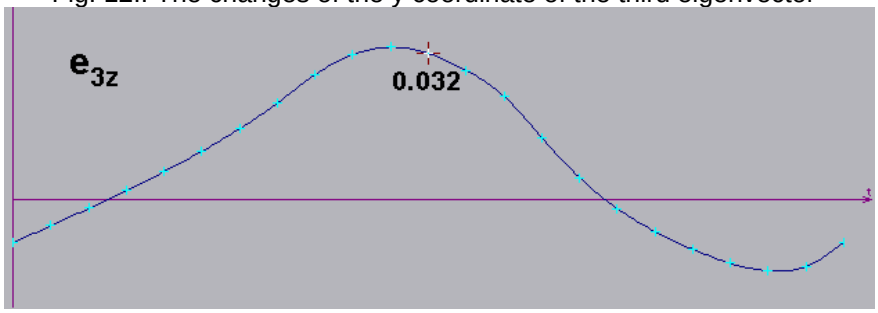

Fig. 13.: The changes of the z coordinate of the third eigenvector

REFERENCES:

Kocsis, L. (1994). Refining of the Hanavan Human Body Model for Kinematic Investigation of Athletes' Motion. In *Proc. XII. International Symposium on Biomechanics in Sports Budapest* (pp. 61-65)