SIMULATION OF DIFFERENT MOVEMENTS IN SPORTS VIA DIRECT DYNAMICS

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KEY WORDS: computer simulation, modeling, impact, wobbling mass, direct dynamics, visualization

INTRODUCTION: A standard method to determine loads on human joints during sports movements is inverse dynamics. This method is problematic for the analysis of movements with high accelerations, e.g., landings in sports, because the measurements used as input and modeling must be adapted with a high degree of accuracy. Even small inconsistencies affect result sensitivity and may lead to large errors in the values of the load. Therefore, a more appropriate method is the analysis of movements with models adapted optimally to the human body using direct dynamics.

METHODS: Using multi-linked wobbling mass models different gymnastics movements were calculated, partly including phases of landings. For this purpose we developed special algorithms for the torques of the joints and force-deformation-relations simulating the behavior of different surfaces, which were used as input.

RESULTS: The body movements were simulated and visualized. By varying the initial conditions and parameters of the model and the surface, the influence on the movement and the load on the joints was investigated.

CONCLUSIONS: The simulation of movements in sports using direct dynamics offers many opportunities for theory and training practice. The condition of the human body and the environment can be varied in an arbitrary manner, the simulated movement can be visualized and the load on the joints can be determined simultaneously.

REFERENCE:

Ruder, H., Ertl, T., Gruber, K., Günther, M. Hospach, F., Ruder, M., Subke, J., Widmayer, K. (1994). Kinematics and Dynamics for Computer Animation. In S. Coquillart, W. Straßer, P. Stucki (Eds.), *From Object Modelling to Advanced Visual Communication* (pp. 76-117). Berlin.