MODELLING AND SIMULATION OF A VIBRATION-DRIVEN SYSTEM FOR 2-DIMENSIONAL LOCOMOTION WITH MOVEABLE INTERNAL MASSES

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Introduction. In this article the modelling and simulation of a system for the 2-dimensional movement on flat ground using a new motion principle is presented. In the context of this article locomotion is defined as “autonomous, internally driven change of location of human beings, animals or machines during which base of support and centre of mass of the body are displaced” . The conversion of (mostly periodic) internal and internally driven motions into a change of external position is called undulatory locomotion.

Vibration-driven system. The locomotion is based on the generation of internal periodic deformations and the use of asymmetric dry friction at the contact between robot and environment. The driving force is produced by a horizontally oscillating mass. The friction force should be manipulated at least at two points to generate a controllable movement. This is realized by two oscillating masses which are modifying the normal force.

On Fig.1 the physical model of vibrating system is presented.

Figure 1 – Physical model

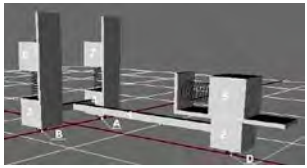

Figure 2 Multibody model

Multibody model. On Fig.2 it is presented a multibody model, consisting of the nearly mass less basis 1 and six steal cubes. Cubes 2, 3 and 4 are fixed at the basis. They present the constant part of the normal force. The other cubes are connected to the basis by linear joints. They are controlled by periodic kinematic functions. Cube 6 and 7 vibrate in vertical direction and cube 5 in horizontal direction. In both models the three points A, B and D have continuously contact to the surface because of the gravitational force. Dynamics in z-direction are not considered. The results of the investigations of the two models are in good agreement.

Conclusion. It is established, that movement of system can be operated 2-dimensional by the frequencies of excitation and angular changes of a phase between functions of excitation of vibrating internal weights.

Literature

Zimmermann, K.; Zeidis, I.; Behn, C.: Mechanics of Terrestrial Locomotion. Berlin. Springer, 2009.