The Motions of the Celt on a Horizontal Plane with Viscous Friction

Maria A. Munitsyna*

* Moscow Institute of Physics and Technology (State University)
e-mail: munitsyna@gmail.com

ABSTRACT

The problem of the motion of a elt on a fixed horizontal plane with viscous friction is considered. The Celt is a convex solid body, one of its principal central axis of inertia being perpendicular to the surface of the body, and the directions of the principal curvatures of the surface at the point of intersection with this axis are not parallel to the other two principal axes. It is well known that the stability of the rotations of this body around the vertical axis depends from the direction of rotation. In most of the papers devoted to this property, the non-holonomic formulation of the problem is considered;it is assumed that the velocity of the point of contact between the body and the plane is zero (see, for example, [1], [3]). In the paper [2] the motion of the celt on a plane with friction is considered, and the consistency of this formulation of the problem with full-scale experiments is confirmed.

In the present paper, the investigation of [1] is continuing, in which it is assumed that the viscous friction force acts on the stone from the side of the plane. This model of friction allows us to carry out not only numerical, but also analytical studies in the problem. In addition, when the coefficient of viscous friction strives for infinity, the force of viscous friction is realized the non-holonomic constraint [4].

On the plane of the parameters of the problem, regions of stability of uniform rotations about the vertical are constructed. The dynamics of transient processes from unstable motions to stable ones is studied. The results of modeling the interaction of the Celt with the supporting plane by the force of viscous friction are consistent with the known properties of its dynamics, and it makes sense to investigate the considered problem further.

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