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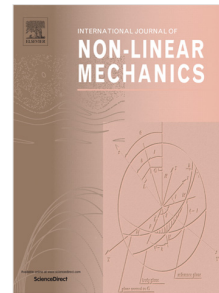
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DYNAMICS OF A RIGID BODY WITH AN ELLIPSOIDAL CAVITY FILLED WITH VISCOUS FLUID

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Abstract

We revisit the approach proposed by F.L. Chernousko to modeling the dynamics of a rigid body with a cavity entirely filled with a highly viscous fluid. Within the approach, a finite-dimensional model of the body+fluid system is offered and the influence of the fluid is represented as a special torque acting upon the body with solidified fluid. Our aim is to develop further and expand a few technical aspects of the Chernousko model. In particular, we offer a coordinate-free form for some essential formulas and consider the case of constrained dynamics. To illustrate the results obtained we explore the motion of a physical pendulum with a fluid-filled cavity on a rotating platform.

Keywords: body with fluid-filled cavity, reduced order model, integral manifold

1. Introduction. Analysis of the dynamics of a rigid body with fluid-filled cavities has a long history. One of the pioneering contributions is due to Stokes [28], who considered cavities of the shape of a rectangular parallelepiped and a circular cylinder. N.Ye. Zhukovskii, following and expanding on Stokes, proved that if the cavity is simply connected and the fluid's velocity has a potential the dynamical behavior of the body remains the same if the fluid within the body is replaced with a certain equivalent rigid body [32]. Greenhill [8] and Hough [10] were the first to study the stability of steady

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