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Optimal braking of the rotations of a rigid body with internal degrees of freedom

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Abstract

We consider motion of a rigid body with internal degrees of freedom: a moving mass coupling viscoelastically or with a square low friction to the body and cavity containing viscous fluid [1,2]. It is assumed the natural oscillations of mass attenuate much more rapidly than the rigid body makes one revolution. The obtained equations of system have the form similar to rigid body equations and torques due to internal dissipation. It is assumed that rotation is braked by means of a control moment that is bounded in modulus, the magnitude of the constraint may vary in time. Our problem is to find the response-optimal braking of the rotations of the system. We need to find an optimal control law, optimal phase trajectory, and minimum value of the functional.

It is conducted the analysis of the axial rotation for controlled motion of the rigid body. It is shown that the direction of the kinetic moment vector in the coordinate system with the body tends to a stationary state, namely to the directions of the axis corresponding to the largest moments of inertia. It is conducted the analysis of the rotations of the body in the equatorial plane. The precession rotations of quasi rigid body with respect to the axis in the equatorial plane are completely defended. In the case when b=const the representations for the nutation angle and the modulus of kinetic moment of the body are obtained.

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