CONTROLLED MOTION OF AN INHOMOGENEOUS BALL ON A HORIZONTALLY VIBRATING PLANE

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Abstract. In this work we investigate the controlled motion of a balanced inhomogeneous ball (the Chaplygin sphere) on a plane performing horizontal periodic oscillations. The motion of the ball is controlled by the controlled rotation of the internal noncoplanar gyrostats. The work addresses two control problems concerning the construction of controls which generate motion along a trajectory given either on a moving plane or in a fixed frame of reference. It is shown that, using a control torque constant in the fixed frame of reference, the general problem can be reduced to the problem of control on the zero level set of the angular momentum integral. It is proved that, on the zero level set of the angular momentum integral, the system under consideration is completely controllable according to the Rashevsky-Chow theorem. Control algorithms for the motion of the sphere along an arbitrary prescribed trajectory are constructed. Examples are given of controls for the ball rolling in a straight line in an arbitrary direction and in a circle, and for the ball turning so that the position of the center of mass, both relative to the moving plane and relative to the fixed frame of reference, remains unchanged.

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