

Modelling and Optimization of Mobile Systems with Internal Moving Masses

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A body containing internal masses can move in a resistant medium, if these masses perform special motions relative to the body. In the paper, progressive motions of a body controlled by internal masses are analyzed in the presence of various types of resistance forces acting upon the body: linear, quadratic resistance, and Coulomb's dry friction forces, both isotropic and anisotropic. Special periodic motions of the internal masses are considered under constraints imposed on relative displacements, velocities, and accelerations of these masses. Optimal relative motions of the internal masses are determined that correspond to the maximal average speed of the system as a whole. Experimental data are presented that confirm the obtained theoretical results. The principle of motion discussed in the paper does not require outward devices such as legs, wheels, screws, tracks, etc. and can be used for mobile robots, especially, mini-robots that can move in tubes, corrosive media, and complex environment.