Controlling the orientation of a polar-orbiting satellite by means of magnetic moments

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The article considers the problem of controlling the orientation of a polar-orbiting satellite in a circular orbit by means of magnetic moments. A direct magnetic dipole has been adopted as a model of the geomagnetic field. The system of equations of motion is linearized in a neighborhood of the relative equilibrium position. A system of equations of controlled motion belonging to a special class of linear nonstationary systems, for which there exists a transformation leading these systems to stationary systems of higher dimension, is explicitly indicated. On the basis of the given stationary system, controllability is investigated; efficient algorithms for optimal stabilization of the satellite relative equilibrium position are constructed. For these algorithms the control action is a function of the stationary system variables of a higher order than the initial nonstationary system. To synthesize control directly in the initial system, auxiliary variables are introduced, so as to make the transition from the state vector of the reduced stationary system to the state vector of the initial system, supplemented by auxiliary variables. The results of mathematical simulation of the constructed algorithms confirming the effectiveness of the proposed methodology are presented.

Keywords: *satellite, orientation, magnetic control systems, linear non-stationary systems, reducibility, controllability, stabilization algorithms*

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