The analysis of possibility of performing the function of the atmospheric braking device by orbital tether system

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The article considers the possibility of performing the function of the atmospheric braking device in the near- circular orbits by the tether system. The terminal elements of the tether system are two parts of the spacecraft that enhance the effect of gravitational stabilization of the tether system, and the connecting tether significantly increases the overall aerodynamic drag and plays the role of an aerodynamic brake. The mathematical model of the motion of bound objects in the central Newtonian terrestrial gravitational field is developed, taking into account the aerodynamic drag force of the atmosphere upper layers and the mass of the tether. This model is represented in the form of an autonomous dynamic system of the second order and mathematical apparatus of the qualitative theory of dynamic systems and the theory of bifurcations is applied for its analysis. Possible types of qualitative structures were constructed, allowing for composing a complete picture of the relative motion of bound objects at different altitudes of motion. Results of the analysis of qualitative structures of phase trajectories give the set of realizable regimes of tether system motion. In circular orbits these regimes are the equilibrium stationary regime, the regime of oscillations of the tether system with respect to the vertical equilibrium position, and the regime of rotation of the tether system around the center of mass. These regimes correspond to the stable particular phase trajectories of the system and the set of orbito-resistant nonsingular phase trajectories that fill the fixed regions of the phase surface with allowance for the obtained conditions for location of the dynamic system on the connection (with a stretched tether).The results of studying the dynamics of the tether system in the upper layers of the Earth's atmosphere confirm the possibility of its application as an atmospheric braking device.

Keywords: *orbital tether system, spacecraft, aerodynamic drag force, atmospheric braking device, equilibrium stationary regime*

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