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THERMAL OPTIMIZATION OF TRAJECTORIES OF SPACE DEBRIS REMOVAL INTO THE EARTH'S ATMOSPHERE

Abstract

A number of active methods of combating space debris involve controlled removal of objects from low Earth orbits into the Earth's atmosphere. The capacity for controlling the process of space debris removal persists in the combined method proposed by the authors in previous projects. In the meantime, the effectiveness of the method depends both on the characteristics of the removed object, and on removal trajectories and associated thermal loads. In this work, the task of optimizing the trajectories of space debris removal into the Earth's atmosphere for the purpose of destruction due to aerodynamic heating is considered. The total amount of heat at the stagnation point of a blunt body is considered as the objective function. A mathematical optimization model has been developed that takes into account the lift-to-drag ratio, ballistic coefficient, characteristic size and pitch attitude for re-entry into the atmosphere of the removed object. Various configurations of removed objects and the influence of the shape on thermal loads are considered. To solve the variational problem that arises when determining the optimal trajectory, a numerical algorithm is proposed using the genetic approach. The results of solving the optimization problem allow determining the area of effective application of certain methods and technologies for removing space debris from low Earth orbits.