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OPTIMIZATION OF THE DESIGN PARAMETERS FOR INTERORBITAL PROMISING TRANSPORTATION REUSABLE SYSTEMS

Abstract

The paper deals with select on design parameters for interorbital promising transportation reusable systems. We study near-Earth and interplanetary transport operations of two types of spacecraft with two profitable propulsion systems types: electric propulsion and engines with chemical components.

The primary criterion of the design optimization is the relative mass of the payload. Introducing specific cost characteristics for each portion of the spacecraft's launch mass easy transforms all problem statements to the cost criterion.

The parametric model of the system mass is the sum of the individual subsystems' masses: the power system, including the solar array; the propulsion system, including the power processing unit associated with each thruster; the fuel mass; the tank mass, including the propellant distribution system; the construction mass. In the first approximation, these masses depend linearly on the rated power of the power plant and the rated thrust of the propulsion system. This design model provides a reasonable first approximation to what a highly detailed model could provide.

We used the provisions of the pulse theory to calculate the spatial interorbital flights with traditional propulsion systems. Controlled motion with low thrust was computed using the approximate analytical dependencies that do not consider the presence of passive sections on the trajectory.

We consider one-time and reusable transportation systems. All kinds of operations include the maneuver of disposing of an expired space tag. For all the considered problem statements, analytical expressions are obtained for the best design parameters of the transport spacecraft, depending on the expected cargo flow.

Thus, these statements cover many practically important tasks of designing space technology and can be used for scientific and technical justification of the implementation of promising space missions.