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Calculating of the Fastest Spacecraft Flights between Circular Orbits

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The problem of optimal reorientation of spacecraft orbit is considered in quaternion formulation. Control (jet thrust vector orthogonal to the plane of the orbit) is limited in magnitude. It is necessary to minimize the duration of the process of reorientation of the spacecraft orbit. To describe the motion of the spacecraft center of mass quaternion differential equations of the orientation of the orbital coordinate system was used. The actual special case of the problem, when the spacecraft's orbit is circular and control equals to its maximum (in modulus) value on adjacent parts of active spacecraft motion, was considered. Original genetic algorithm for finding the trajectories of spacecraft fastest flights is built. In this case the lengths of the active sections of the spacecraft motion are unknown. This method does not require any information about the unknown initial values of conjugate variables. The high speed of operation of the proposed genetic algorithm is achieved through the use of existing, in this case, a known analytical solution of equations of the problem. Examples of numerical solution of the problem for the case when the difference between the initial and final orientations of the spacecraft's orbit equals to a few degrees in angular measure, are given. The final orientation of the spacecraft's orbit corresponds to one of the satellites of Russian GLONASS orbital grouping. The graphs of components of the quaternion of orientation of the orbital coordinate system, the deviation of the current position of the spacecraft's orbit to the required and optimal control are drawn. Specific features and regularities of the process of optimum reorientation of the spacecraft's orbit are given.

Key words: spacecraft, orbit, optimization, gene.

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