SPACE EXPLORATION SYMPOSIUM (A3)
Solar System Exploration (5)

Author: Dr. Nikolay Sokolov
Central Research Institute of Machine Building (FSUE/TSNIIMASH), Russian Federation,
sokolov@mcc.rsa.ru

Dr. Victor Ivanov
Central Research Institute of Machine Building (FSUE/TSNIIMASH), Russian Federation, sov@mcc.rsa.ru
Mr. Denis Zelenov
Central Research Institute of Machine Building (TSNIIMASH), Russian Federation, zelenov@mcc.rsa.ru
Mr. Nikolay Panichkin
Central Research Institute of Machine Building (FSUE/TSNIIMASH), Russian Federation,
acad10@mail.ru

BALLISTIC AND NAVIGATION ASPECTS OF CONTROL ISSUES FOR JUPITER AND ITS SATELLITES EXPLORATION MISSIONS

Abstract

Today the available information about Jupiter and its satellites is insufficient for the well-defined estimation of planet physical characteristics and its adjacent space. The atmosphere sounding satellites functioning on the planet's satellite orbits must contribute to Jupiter system exploration. The main tasks are investigated which decision predetermines the choice and validation of control technology and spacecraft design: -definition of rational ways for interplanetary transfers; -selection and validation of control programs for maximization of physically realizable spacecraft reentry corridors; -determination of control programs which provide the conditions for effective operation of scientific gear during the spacecraft motion in the atmosphere; -selection of design-ballistic specifications and spacecraft control modes which meet the requirements of allowable temperature and overload spacecraft modes. The main obtained results: 1. Relative approach velocities of spacecraft to Jupiter can be considerably reduced in case of spacecraft co-rotational reentry. 2. With spacecraft motion inside the reentry corridor commeasurable with the navigation one ($\Delta \mathrm{h}_{nav} < 1000km$) and taking into account the possible variation of atmosphere parameters, maximum overload values can run to 500 for ballistic type spacecraft and 400 for spacecraft with maximum aerodynamic quality not less than 0.3. 3. With the adequate control programs the spacecraft speed bleedoff from the initial value $V_0 = 48 - 60km/s$ up to the finite one V_f =0.8-1.2 km/s for the spacecraft with the values of reduced frontal surface load $P_x = 200 - 400kg/m^2$ finishes at rather high altitudes $h_f = 35 - 45km$, which provides the conditions for the proper performance of the scientific gear. 4. With the existing accuracy of self-contained navigation system, possible variation of atmosphere parameters and judicious selection of maximum allowable overload modes during the descent in Jupiter atmosphere, it is necessary to use the spacecraft controlled by aerodynamic quality not less than 0.3. At that the values of maximum allowable overloads can be reduced to 250. 5. The tasks of optimal path selection of spacecraft thermal loading are solved. Either the minimum of maximum temperature value or the minimum of integrated heat flux were used as the optimality criteria depending on the surface insulation system.