

SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)

Strategies & Architectures as the Framework for Future Building Blocks in Space Exploration and Development (1)

Author: Ms. Tatyana V. Labutkina
Dnepropetrovsk National University named after Oles' Gonchar, Ukraine

Prof. Olexandr Petrenko
Dnepropetrovsk National University, Ukraine
Prof. Vladimir O. Larin
Dnepropetrovsk National University, Ukraine
Mr. Vladimir Belikov
Dnepropetrovsk National University, Ukraine

GLOBAL PLANNING AND CONTROL OF MULTITUDE OF SPACE VEHICLES FOR FORMING "WINDOWS" FOR LAUNCHING INTO ORBITS AND INTER-ORBITAL TRANSITIONS

Abstract

At present the space vehicles represent a substantially smaller share of the total multitude of the orbital objects in the near-Earth space. The larger part is, so far, objects of space debris. The number of orbital objects in the near-Earth space grows so fast, that now the space debris imposes complications in solving tasks in the space. An obvious assumption is that the problem of space debris will be solved over time. Then the main part of the multitude of orbital objects will be space vehicles. Further growth of the number of controlled space vehicles can also cause the risk of collisions between them. Therefore, even at present it is necessary to set the tasks of centralized planning of development of the multitude of controlled orbital objects. This requires not only provision of orbital motion without conflicts for the elements of this multitude. Impossibility to provide non-conflict launch of space vehicles and their inter-orbital transitions may become a problem for their missions. This problem should be considered already now, and the increase of the number of the space vehicles is to be done with taking it into account.

A solution of this problem may be formation of windows for launching space vehicles and their inter-orbital transitions within the multitude of orbital objects. Such windows may be "stationary" (provided by selection and maintenance of certain orbital parameters of the vehicles), and dynamical (created in given time intervals by controlled temporary change of their trajectories). The second approach is more perspective, though requires maneuvers, which are to be safe.

To provide non-conflict windows by planning orbital motion of space vehicles is extremely difficult. We propose another approach. As a collision of space vehicles is possible only when there are sufficiently close segments of orbits, it is proposed to form windows in the **multitude of trajectories**. A window is deemed to be free if there are no trajectories of space vehicles in it. Since orbits of the vehicles change substantially slower than the vehicles move on them, such windows can be created and maintained during a given time.

Several global strategies of forming such windows have been considered. A method of selection of parameters in the orbital groups of vehicles providing formation a window in the group has been developed. The method takes into account the accuracy of correction of orbital motion of space vehicles and uncorrectable precession of the orbital planes.