

IAF ASTRODYNAMICS SYMPOSIUM (C1)
Guidance, Navigation and Control (2) (4)

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IN-ORBIT LARGE SPACE STRUCTURE ASSEMBLY USING REPULSIVE SPACECRAFT-ROBOT
WITH MANIPULATORS**Abstract**

On-orbit assembly is expected to be a tendency of next-generation space exploration. It allows to place large structures in near-Earth orbit and to facilitate continuous exploitation and modernization of space missions. While self-assembling structures are thoroughly considered, it is necessary to pay attention to tug-based assembly.

In this work, servicing spacecraft motion control in problem of in-orbit truss structure assembly is investigated. It is considered that container with beam set and servicing spacecraft are on orbit initially. Assembly algorithm is based on spacecraft motion relative to the structure specified points. The spacecraft is equipped with two robotic manipulators capable of attaching to the structure and holding rods. In addition, the spacecraft can repulse from the structure with a given relative velocity using a manipulator, so the spacecraft and the structure receive impulses. The repulsion vector is calculated in order to reach the structure target point. If the task of transition between two structure points cannot be solved by repulsion only, then the repulsion is used to move closer to the target point. In this case the onboard spacecraft propulsion control is used to reach the target point.

This work investigates the spacecraft controlled motion in structure assembling problem. The spacecraft motion control is performed by repulsion using manipulator or/and on-board propulsion. The motion control is considered as pulsed or continuous. An objective function for finding the repulsion vector or the control impulse is proposed. Also, the performance of application of feedback control, such as proportional-differential control or linear-quadratic regulator, and an artificial potential field associated with the structure shape is investigated using numerical simulation. The application of the proposed control scheme is applied to the problem of truss-based antenna is demonstrated. The results of the study is presented, and main features and limitations of assembly problem using spacecraft with two manipulators are discussed.