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2-BLADES DEPLOYING BY CENTRIFUGAL FORCE SOLAR SAIL EXPERIMENT

Abstract

Up to the present moment there were not so many pico- and nanosatellite missions with high energy trans-orbital or interplanetary transfers. Especially it was caused by the adaptation difficulties of traditional propulsion devices, such as liquid or solid propellant engines. Solar sail as a propulsion device was proposed to solve this problem. The good example of solar sail nanosatellite mission was Nanosail-D launched by NASA in 2010. Some various possible solar sail designs were discussed by us. The design of 2-blades solar sail was proposed. This design is similar to the Heliogyro Solar Sail design by MacNeal [1], but we analyzed that 2-blades design can provide good attitude capabilities for the spacecraft. The spacecraft with 2-blades solar sail can change it attitude with simpler kinematics unlike the Heliogyro design. Based on theory of gyros rotating around single point we analyzed that rotating of 2-blades solar sail is a very unstable process – so, we can use this for our purposes. We proposed the BMSTU solar sail experiment roadmap. It consists of two major milestones:

1. LEO experiment without large solar sail deployment. In this mission we are going to test the solar sail deploying subsystem. The satellite was called as a Demonstrator satellite.

2. MEO experiment with large solar sail deployment. We are going to deploy 10 m2 solar sail. During the flight we will test our orbital model for future purposes.

We finished structural design of a Demonstrator satellite, most of the onboard systems were tested. Also we developed a mathematical model of solar sail deployment and dynamics. The dynamic model of orbiting satellite with solar sail was discussed, several parts were programmed. The functional model of onboard radio transmission equipment and ground station for the first mission were designed and manufactured. This work is conducting by a group of about 30 students and professors based on BMSTU Youth Space Center. Based on the results of the work we will unite all of BMSTU research and develop capabilities in a very great challenge – the developing of one of the first student-made interplanetary mission to the Moon.

[1] MacNeal, R. H., "The Heliogyro, An Interplanetary Flying Machine", NASA Contractor's Report CR 84460, June 1967.