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Educational Pico and Nano Satellites (4)

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SOLAR SAIL-DRIVEN NANOSATELLITE CONSTELLATION FOR SUN ACTIVITY MONITORING

Abstract

Today it is a matter of the fact that small satellites become more and more highly-demanded due to their ability to solve a significant amount of technical and scientific problems with less time and material inputs.

Taking into account that a group of small satellites is often even more useful than one big spacecraft, we started a project of nanosatellite constellation for Sun observation.

The primary project goal is nanosatellite constellation formation for continuous observations of solar activity and plasma microflares. For this mission, we need at least two satellites to achieve nearly persistent Sun observation.

The payload is a highly-sensitive spectrophotometer made by P.N. Lebedev Physical Research Institute of Russian Academy of Science, Laboratory of X-Ray Astronomy of the Sun. It can measure X-Rays in the energy range of 1-20 keV with a resolution 200 eV.

Design of the satellites is fitted to the 1,5U CubeSat standard. Both CubeSats will be orbited in one container during piggyback launch. We propose to use two-blade rotary solar sail (heliogyro type) for the nanosatellite maneuvering in the Low Earth Orbit, using the solar sail as a combined solar and drag sail. The use of the solar sail reduces the time needed for orbital separation of two satellites from the initial point. We proposed an algorithm of constellation deployment using sequential folding and unfolding of the solar sail.

Each nanosatellite utilizes newly developed attitude control and determination system, power system, communication and other systems to achieve a high equipment density inside the small 1.5U volume.

Apart from the scientific and technical roles of the project, there's a substantial educational program based on it. The team of BMSTU students, both undergraduate, graduate and postgraduate, and young professionals designs all the onboard systems and mathematical models. It is an excellent opportunity of developing engineering skills and getting experience in space technology.