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USING THE SPACECRAFT WITH A SOLAR SAIL TO MONITOR A SPECIFIC AREA OF MARS

Abstract

Mars is the next milestone in our exploration of the solar system. Today the world space community, particularly United States, Russia, Europe, India and China, actively introduce plans and develop projects for the manned landing on Mars. Plans for research and exploration of Mars require the creation of not only advanced structures on the surface of the planet, but also the orbital system maintenance habitable base. This paper analyzes the use of a spacecraft with a solar sail to observe the surface and atmosphere of Mars given area as well as provide communication. The paper presents a mathematical model for a possible device design, developed on nano-satellite class CubeSat platform.

Spacecraft can be delivered and put into an areocentric orbit as an additional payload in the delivery of goods or settlers on Mars. Once deployed, the sail spacecraft will go into a levitating orbit that allows the best possible overview of the required area on the surface of Mars. In the present study we consider and analyze a sail's and orbits' parameters that provide target non-Keplerian orbit. We propose a mathematical model of a controlled motion of the spacecraft with a solar sail, taking into account the gravitational field of Mars and the Sun, the solar radiation pressure force, as well as the resistance of the upper atmosphere of Mars. When the preferred landing site on Mars is identified, based on the coordinates of the place the model allows to find parameters of the desired non-Keplerian orbit. The effectiveness of the proposed mathematical model to generate and maintain the desired non-Keplerian orbit, and dependences of the design parameters of the spacecraft with a solar sail on the coordinates and size of the surveillance area on the surface of Mars are addressed and analyzed.