Paper ID: 62206
student

Exploration of Near-Earth Asteroids (4)
Exploration of Near-Earth Asteroids (1) (1)

Author: Mr. Maxim Pupkov
Bauman Moscow State Technical University, Russian Federation

Dr. Natan Eismont
Space Research Institute (IKI), RAS, Russian Federation
Mr. Konstantin Fedyaev
Space Research Institute (IKI), RAS, Russian Federation
Mr. Vladislav Zubko
Space Research Institute (IKI), Russian Academy of Sciences (RAS), Russian Federation
Mr. Andrey Belyaev
Space Research Institute (IKI), Russian Academy of Sciences (RAS), Russian Federation
Mr. Nikita Simbiryov
N.E. Bauman Moscow State Technical University, Russia, Russian Federation
Prof. Ravil Nazirov
Space Research Institute (IKI), RAS, Russian Federation

AN APPROACH TO STUDY NEAR-EARTH ASTEROIDS BY AN OPERATING SPACECRAFT AFTER THE COMPLETION OF ITS MAIN MISSION

Abstract

The current research is devoted to investigation of prospects of using an operating spacecraft for exploring Near-Earth asteroids as an extension of its main mission. In particular, we consider a spacecraft in a bounded orbit around the collinear Sun-Earth libration point. If the main onboard systems of the spacecraft are still functioning after the main mission is complete and there is a sufficient amount of propellant left, the spacecraft may be redirected to a close approach with one of the Near-Earth asteroids (or even several ones) to study it from a flyby trajectory. An example of this approach is the famous ISEE-3/ICE project, which was initially aimed at studying the solar wind in the vicinity of the Sun-Earth libration point L1 and then, after a number of Lunar gravity assist maneuvers, was successfully targeted to the Giacobini-Zinner comet.

A possibility of determining mass and other physical characteristics of asteroids using flight dynamics methods is discussed. Namely, it is proposed to assess gravitational influence of the asteroid on the spacecraft trajectory. As an example, we consider the Spectrum-Roentgen-Gamma (SRG) Space Observatory which is currently in an orbit around the Sun-Earth libration point L2. The main mission of SRG, with its telescopes, is to measure the X-ray radiation of celestial objects. In addition, the Observatory is equipped with optical instruments for determining its orientation. According to preliminary estimates, by approximately 2029, after completing its current mission, the SRG Observatory will have enough onboard fuel for the orbital and orientation maneuvers necessary for a fairly close flyby of some asteroids. This date is of particular interest because it coincides with the close approach of the Apophis asteroid to the Earth. Thus, Apophis, including estimating its mass, is considered to be one of the most preferable targets for additional studies. It is confirmed that with appropriate orbital maneuvers that meet the Delta-V constraints, it is possible to approach Apophis close enough for a minimum detectable deflection of the spacecraft trajectory, which makes it possible to estimate Apophis' mass with sufficient accuracy. Also a number of other asteroids can be considered as candidates for possible SRG flybys in order to determine

their mass from the Observatory's tracking data. The proposed concept can be applied to other spacecraft for additional use in the final stages of their missions. Preliminary calculations show good prospects for this approach.