27th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Spacecraft for Deep-Space Exploration (8)

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AUTONOMOUS NAVIGATION STRATEGY ON THE LICIACUBE MICRO-SATELLITE FOR CLOSE PROXIMITY FLY-BY OF THE DIDYMOON ASTEROID

Abstract

Next deep-space exploration missions face with unprecedented technical difficulties to overcome, often without the large budgets of the past. With this spirit, NASA DART mission to Dydimos system will demonstrate for the first-time asteroids deflection technologies at extreme distance from Earth. The DART spacecraft will carry on-board the LICIACube micro-satellite, developed by Argotec within an Italian Space Agency project with the cooperation of INAF, University of Bologna and Polytechnic of Milano, during its journey to Dydimos. LICIACube will be released prior to DART impact with Dydimos B and will perform a fly-by of the asteroids collecting invaluable images during the last moments of the DART spacecraft mission. With a relative speed of about 7km/s and a closest approach distance of only 50km, LICIACube fly-by of Didymos B requires an angular velocity in the order of 10deg/s to guarantee target pointing, being one of the fastest maneuvers of this type to be ever attempted by any class of space probes. To perform this mission, Argotec is making use of its autonomous navigation technologies, adopting the purpose-built HAWK-6 deep-space platform already used for the ArgoMoon mission. This paper

aims at presenting the autonomous navigation strategy used for LICIACube. A unit-level description of the parts included into the autonomous navigation system is provided, with a focus on the Imaging Subsystem and the attitude/orbit determination and control. Given LICIACube fly-by dynamic, the requested performance goes beyond the state-of-the-art in terms of real-time image processing, on-board time synchronization and pointing accuracy. The non-obvious task to make these requirements compatible with the limited capability of a modern 6U platform is investigated. Subsequently, an overview about both unit-level and system-level verification strategies is included. Finally, the overall system performance is discussed, with an associated analysis in regards to potential future missions enabled by the technologies in object.