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PICO-SATELLITE PLATFORMS AS EFFECTIVE SENSORS FOR IN-SITU ASTEROID CHARACTERIZATION

Abstract

In the study of Near Earth Objects (NEO), it is crucial to advance our current modelling capabilities of Potentially Hazardous Asteroids and imminent impactors, especially smaller size ones. This would allow for more accurate and more timely prediction of their effects and, ultimately, for a more effective protection of our planet. This objective can be achieved by enabling key technologies that can be utilised in support to missions to NEOs, in particular for in-situ validation of theoretical models of their properties. The design requirements for these technologies are derived from the modelling needs of the target body (asteroid dynamics, surface characteristics, topography, temperature in various locations) in terms of modelling capabilities, parameters to be measured for model validation, required measurement accuracy and resolution. One of the in-situ characterization technologies currently under investigation at Delft University of Technology is the so-called "PQSmartNet", which makes use of the PocketQube satellite platform developed by the Space Systems Engineering group. PocketQubes are cube-shaped platform based on 50 mm3 units with a mass of less than 250 g each. Delft University of Technology has embarked in the design and development of this class of picosatellites in order to further advance its research on satellite miniaturization: a PocketQube, by definition, has 8 times less volume when compared to a CubeSat. Potentially, deep space and interplanetary missions can gain even more advantage from the use of large networks of these very small satellites, by reducing costs, improving redundancy and assure high scientific return through their use in big numbers. In the innovative PQSmartNet, a number of PocketQube devices, equipped with a full suite of sensors and radio beacons, are used to sense the surface of an asteroid, measure its temperatures in various locations and its dynamics and rotational speed, while directly transmitting the gathered scientific information to the Earth. These PocketQube units represent the nodes of a net that can fully wrap and cover the entire surface of a small asteroid up to a few meters in size, with the net wires representing at the same time an antenna for direct communication from the PocketQubes to the Earth or a mother spacecraft. The PocketQube units are also equipped with hooks, to increase the chances for anchoring a body with very low gravity field. This paper presents the preliminary design of the PQSmartNet and the expected challenges for its development and in-situ validation in an actual space mission.