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TETHERED ELECTROMAGNETIC CAPTURE: A CUBESAT MISSION CONCEPT

Abstract

In this paper a concept demonstration mission employing a 2U CubeSat is proposed, aiming to prove the feasibility and the effectiveness of tethered soft docking procedure between two collaborative spacecraft making use of magnetic forces. Until today, no space demonstration of mating technologies for CubeSats has been successfully performed, due to a lack of viable solutions in alternative to the classic, very resource-demanding docking mechanism such as robotic arms and gender-mate port; in fact, a reliable solution for small vehicles is still to be found. In this contest, the Tethered Electromagnetic Docking (TED) is a new technology under study, to overcome the limitations of classical mating systems reducing the proximity navigation and guidance requirements between chaser and target spacecraft. In the paper, the CubeSat main subsystems are outlined along with a conceptual design of the structures. The TED payload is then introduced, consisting in an electromagnetic probe connected with a tether to a launch and rewind system, and a target interface acting as drogue; the goal is to test the whole docking procedure, capturing the target by means of an electromagnetic probe and pulling it back to the mother satellite by rewinding the tether. The target and the main vehicle structure are physically connected throughout the whole mission: before test operations, the target is deployed from the CubeSat by means of an extendable structure. Multiple tether unwind/rewind cycles are foreseen, to repeat the docking procedure and collect statistically relevant experimental data. For the different subsystems, concurrent technical solutions are presented and a complete conceptual design is defined thanks to a trade-off between them.