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ERMES: TESTING AN AUTONOMOUS DOCKING MANOEUVRE DURING ESA FYT 2022 PARABOLIC FLIGHT CAMPAIGN

Abstract

In the last few years, the advent of the so-called *New Space Economy* has led to an increasing number of CubeSats in space missions. In fact, different companies and research laboratories are currently focusing on small satellite solutions due to their reduced dimensions, production time and costs. As a consequence, scientific experiments and technological demonstrations involving miniaturized systems with high reliability and performance have markedly increased due to their effectiveness for several applications, e.g. related to on-orbit servicing.

Experimental Rendezvous in Microgravity Environment Study (ERMES) is a student project, which has as its main objective the design of a technological demonstrator to test an autonomous docking manoeuvre between two free-flying CubeSats mock-ups in a reduced gravity environment. The experiment has been

selected by the *European Space Agency* (ESA) education office, for the *Fly Your Thesis! 2022* (FYT), and performed during the 79^{th} *ESA Parabolic Flight Campaign*.

The two mock-ups involved in the experiment are equipped both with a Guidance Navigation and Control (GNC) system and miniaturized docking interfaces. During the manoeuvre, they work in a Target-Chaser configuration, where the Chaser is active while the Target is cooperative. In particular, the Chaser has a cold gas propulsive system based on expendable CO_2 cartridges for manoeuvring, whereas the Target has a set of reaction wheels for attitude control.

This paper presents an overview of the experiment, pointing out the key features of its design, then it focuses on a detailed discussion of the results from the analysis of the data collected during the campaign. Relevant focus is given to the investigation of the operation of the dedicated Proximity Navigation Software of the Chaser, by confronting the trajectory computed by the On Board Computer System (OBCS) and the real trajectory obtained from an external reference camera.