Paper ID: 13657
oral
student

ASTRODYNAMICS SYMPOSIUM (C1)
Guidance, Navigation and Control (3) (3)

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PROPELLANTLESS RENDEZ-VOUS OF QB50 NANOSATELLITES

Abstract

Because nanosatellites have currently very limited maneuverability, the long-term objective of the research is to develop a novel control method for propellantless rendez-vous and formation flying of nanosatellites by using the differential aerodynamic drag concept. The proposed algorithm will be validated on-orbit within the framework of the QB50 constellation. The low orbital altitude chosen for the QB50 mission (i.e., an initial altitude of 320 kms) is particularly suitable for this mission.

The active spacecraft, termed the chaser, will be a three-unit CubeSat developed at the University of Liège. To achieve the rendez-vous with another (passive) CubeSat of the constellation and execute maneuvers, the level of aerodynamic drag of the chaser will be modified by imposing its cross section, in order to create a (differential) force between the target and the chaser. For this purpose, miniturized reaction wheels will be used to change the chaser's frontal surface, and efficient optimal control techniques will be developed to control the wheels.

The paper will present a detailed analysis of the mission concept. Thanks to both advanced orbital dynamics calculations and analytical developments, it will discuss its feasibility within the constraints imposed by the QB50 network. The use of differential drag for rendez-vous of higher-altitude satellites will also be discussed to show that this technology is potentially very interesting for nanosatellites which have very tight mass and volume constraints.