Paper ID: 19507
oral

20th SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Distributed Space Missions (7B)

Author: Mr. Salvador Llorente
SENER Ingenieria y Sistemas, S.A., Spain

PROBA-3 MISSION FOR DEMONSTRATION OF PRECISE FORMATION FLYING TECHNOLOGIES

Abstract

A fundamental change in the future of the space mission is expected to be achieved with the implementation of precise Formation Flying(FF) technology. FF will allow deployment of very large and "reconfigurable" virtual structures in space. For instance, it will allow the construction of instruments with unprecedented and adjustable dimensions and parameters, by distributing instrument components in several SCs flying in formation. A significant number of conceptual design, analysis, simulations, and even partial HW testing on-ground have been performed during the last years, but the limitations of the ground verification, determine that confidence of the behavior of the formation flying mission will only be possible by demonstration in flight of the concept and the technologies. PROBA-3 is the mission being developed by ESA for in-flight precise Formation Flying demonstration, with the objective to guarantee the feasibility, maturity and operability of the different technologies involved, including formation metrology, propulsion, formation control, operation, safety, etc, in many different formation phases, like acquisition, precise formation, retargeting, reconfigurations, collision avoidance, perigee passes, etc..The mission is entering now in its implementation phase C. The mission consists of two small spacecraft in the range of 200-300kg flying in a formation with relative position control accuracy of less than 1 mm. The two spacecraft will be controlled in space as if they were two parts of a telescope (i.e. lens and detector). This virtual rigid structure will be commanded to rotate and point to any desired direction. It will also be possible to set the relative distance of the two spacecraft from 25 to 250 meters (i.e. change the focus). The end-to-end validation of the FF technologies will be achieved with the application of a coronagraph instrument that will make science by taking pictures of the inner solar corona while one of the two spacecrafts (Occulter) is blocking the Sun. The precise FF demonstration requires a low gravity gradient region that will be achieved during the apogee of a highly elliptical orbit. The selected orbit has perigee height of 600 km and 100 times higher apogee (60.000 km). The formation is broken and reacquired every 20 hours, since precise formation is unaffordable at perigee. The PROBA-3 spacecraft are designed to execute autonomously this orbital routine with no real-time support from ground. This paper will introduce the main objectives, technologies, mission design and achievements of the mission, with some results from the preliminary design phase.