26th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Interactive Presentations - 26th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (IP)

Author: Mr. Sergio Tiraplegui Riveras
SENER Ingenieria y Sistemas, S.A., Spain

Mr. Daniel Serrano
SENER Ingenieria y Sistemas, S.A., Spain
Dr. Luis F. Peñin
SENER Ingenieria y Sistemas, S.A., Spain
Mr. Rafael Contreras
SENER Ingenieria y Sistemas, S.A., Spain

ON-BOARD MANAGEMENT OF AUTONOMOUS FORMATION FLYING SMALLSATS IN PROBA-3 MISSION

Abstract

Proba-3 (#) is ESA's high accuracy precision formation flying space mission. The mission consists of 2 smallsats in a highly elliptical orbit which control their relative orbits performing several formation flying activities. The mission covers two main objectives: the observation of the solar corona with unprecedented accuracy, and the demonstration of the necessary formation flying technologies for future applications.

The system consists of two SC: the Coronagraph SC, or CSC, which carries the optical payload for observation of the Sun; and the Occulter SC, or OSC, which carries a disk and is in charge of performing the actuations to maintain adequate relative status for Sun occultation during the apogee phase of the 19.6 hours orbit.

This implies that complex sequences of activities must be performed every revolution. The spacecraft must break and re-acquire the formation, while ensuring that they will not collide during the "non-controlled" phase. Moreover, due the small size of the satellites and the limited resources, the units, metrologies and payloads have to be specifically managed depending on the needs, so that the power budget and thermal limits are not exceeded.

All these activities must be executed on-board in a fully autonomous and coordinated manner, without any ground support or surveillance for 8 days. However, it must be also ensured that each spacecraft is capable of surviving as a fully autonomous vehicle without any dependence on the companion for the non-operational phases.

In order to overcome the challenges and complexity of the required activities, plus allowing a flexible design, the on board system has been divided in different modules, each one in charge of managing different aspects of the mission. Up to 8 different entities have to be configured autonomously in very specific ways, so that their needs and conditions are fulfilled while ensuring a correct inter-cooperation.

Such an on-board modularity provides great flexibility but results in a system with more than 1000 potential configurations per SC that need to be autonomously managed.

The present paper provides an insight on the way the different difficulties have been overcome, as well as information about the complex management happening on board that is required in order to ensure that the scientific objective of the mission is achieved.

(#) *Luis F. Peñin et al., Proba-3 Mission: Creating an artificial solar eclipse every day by spacecraft flying in formation, 69th International Astronautical Congress (IAC), Bremen, Germany, 1-5 October 2018*