

IAF SPACE OPERATIONS SYMPOSIUM (B6)  
New Space Operations Concepts and Advanced Systems (2)

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PROBA-3 MISSION – COMMISSIONING AND OPERATING SAFELY THE FIRST EVER  
HIGH-ACCURACY AND HIGHLY AUTONOMOUS FORMATION FLYING MISSION

**Abstract**

One of the most challenging upcoming missions for ESA is Proba-3, which is currently scheduled to launch in approximately 2 years' time. The mission consists of two 250kg smallsats which will fly in formation separated several hundred meters apart but autonomously controlled to millimeter and arc-second accuracy with respect to each other.

The concept of formation flying leads to the definition of the relative orbit as opposed to absolute orbit. While both Proba-3 SC fly in an almost identical 19.6h Highly Elliptical Orbit, it is their relative trajectory which defines when the SC can operate nominally, are in imminent collision risk, or can be left in a long-term passively safe state. Proba-3 takes advantage of the low-perturbation period around apogee to perform most of its tasks, but this relative orbit is not collision-risk-free and must be autonomously reconfigured every single orbit to ensure a safe perigee pass and reacquisition of the favorable relative conditions for the following apogee.

Reaching this level of autonomy and safety starting from a single stack of un-commissioned and un-calibrated spacecraft after launch is no simple task. The mission commissioning needs to progressively build-up autonomy while ensuring safety. While in stack configuration, the vehicles exercise as many standalone functionalities as possible before the stack is split into two individual spacecraft several weeks into the flight. These 2 new independent spacecraft are then left in a relative drifting trajectory which needs to be recovered as soon as possible, and transition to a non-drifting relative safe orbit. The

mission operations team will then be faced with the task of commissioning the formation and calibrate the metrologies and sensors to ensure that the vehicles can transition to their operational orbit and autonomously return to their safe orbit in case of need.

Proba-3 nominal operations are dominated by the fact that it will be commanded by one single Ground Station in the Azores' archipelago. This leads to having erratic and non-repeatable pass configurations which can last for several hours, but can then take several days without providing coverage of the orbit phases during which the most critical operations happen.

The paper presents the concept of operations necessary to commission and control a highly complex mission such as Proba-3, with multiple difficulties that have never been addressed in detail before. These technical challenges must be overcome in the constrained framework of a low-cost smallsat mission.