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FORMATION FLYING CAPABILITIES USING SMALL & NANO SATELLITE COMBINATION: PROBA-CUBE DISTRIBUTED SYSTEM

Abstract

Building further on the flight heritage of the successful European PROBA missions (flying in orbit), QinetiQ Space is developing opportunities to benefit from both the Small Satellite and the Nano Satellite worlds. Combining a typical PROBA satellite (150kg) and two typical Nano-satellites (3kg), PROBA-CUBE mission aims at demonstrating the feasibility of performing high precision multi-point measurements through the use of distributed functionalities and instruments over several satellites flying in close formation.

Multi-point missions up to now (Cluster, MMS) are very expensive since they require multiple full capability spacecraft and multi-launches. In collaboration with the European Space Agency (ESA), PROBA-CUBE will provide a much cheaper system by considering one "Mother" spacecraft (MSAT) taking two "Daughter" spacecrafts (DSAT) on board. The system can be drastically simplified by carrying a simple mother-daughter communication link and centralize the intelligence and the downlink capabilities in the MSAT only. DSATs are intended to be propulsion passive while the MSAT would take a traditional hydrazine propulsion system. This allows formation control during nominal activities but also during deployment since all DSATs are accommodated inside the MSAT.

In addition, PROBA-CUBE concept allows scientific innovation through the use of distributed instruments (Magnetometers, Langmuir probes) spread over the three satellites. These payloads will cover both the large and the small horizontal and vertical scales of polar aurorae.

This paper will introduce the mission and will cover all aspects of the formation and satellite system design. It will focus on the distribution of the different functionalities and instruments, allowing the combination of the best aspects of both worlds (Small and Nano satellites). Challenges regarding formation control will be discussed with their solutions. Finally, the paper will be concluded by presenting the capabilities of such an architecture given to the scientific community to perform observation and science through multi-point measurement at a limited cost.