

SMALL SATELLITE MISSIONS SYMPOSIUM (B4)
Small Satellite Operations (3)

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PRISMA OPERATIONAL CONCEPT: SERVICING A VARIETY OF EXPERIMENTAL TEAMS FOR
THE FLIGHT DEMONSTRATION OF FORMATION FLYING TECHNOLOGIES

Abstract

The PRISMA in-orbit test-bed was launched on June 15, 2010 to demonstrate strategies and technologies for formation flying and rendezvous. The Swedish Space Corporation (SSC) is the prime contractor for the project which is funded by the Swedish National Space Board with support from DLR, CNES, and DTU. This paper demonstrates the overall operational concept and how PRISMA is operated by SSC, including experiment definition and programme design, timeline planning and rescheduling, programme validation, on-board execution, and data archiving. PRISMA consists of two spacecraft: Mango and Tango. Mango is 3-axis stabilized and has a propulsion system providing full orbit control capability. Tango has a solar magnetic control system without orbit control capability. The satellites were launched clamped together into a 700 km altitude sun synchronous orbit. After initial commissioning, Tango was separated from Mango on August 11. PRISMA includes the flight qualification of a series of sensor and actuator systems as well as the in-flight execution of a range of GNC experiments using this equipment. The spacecraft have Vision Based, GPS, and RF-sensor navigation systems and have three different propulsion systems. As a result of this variety of interests in the mission, the operational timeline is packed with different experiments and the short ten-month mission requires a high degree of flexibility from mission control and the experimenters themselves. Apart from SSC's GNC experiments, the propulsion developers (ECAPS and NanoSpace) as well as DLR, CNES, and DTU act as experimenters. External experimenters are invited to SSC's Mission Control Centre in Stockholm when their experiments take place. In particular DLR and CNES have GNC-experiments for which their software has been integrated into the over-all PRISMA on-board software. Execution of these experiments includes the handover of closed loop orbit control. PRISMA is operated with the SSC-developed RAMSES ground control system, which is used both for operations and as EGSE during system development. Static flight control procedures are validated on a real-time hardware-in-the-loop spacecraft simulator. The simulator is configurable for varying degrees of hardware-in-the-loop ranging from computer boards only, up to the inclusion of advanced sensors. Based on the validated flight control procedures, the actual experiment programmes are validated on another 40 times faster than real-time simulator having full functional representation of the GNC software. Since the on-board software and simulation models were developed using model based design techniques, it is possible to ensure a high degree of representativity and similarity between these environments.