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TIM: AN INTERNATIONAL NANO-SATELLITE FORMATION FOR PHOTOGRAMMETRIC EARTH OBSERVATION

Abstract

The objective of the Telematics International Mission (TIM) is generation of 3-dimensional images of the Earth's surface by taking advantage of different directions to a given joint target area by photogrammetric methods. Here by distributed system technologies a formation of 12 pico-satellites is realized in cooperation of 14 partner institutions from 5 continents within the Regional Leadership Summit (RLS) program. As specific application, the characterisation of ash clouds from volcano eruptions is in focus, addressing ash distribution profiles in different heights. This provides useful information to plan detour maneuvers for airplanes to avoid damage of their engines.

Technology challenges to enable such innovative photogrammetric observations at nano-satellite level concern precision attitude control and relative navigation techniques, as well as inter-satellite links to provide the appropriate basis for distributed control approaches. This way self-organization within the formation is realized to enable optimal observations. Crucial was in particular the development of a miniature reaction wheel in order to enable 3-axis attitude control by a combination of 3 wheels, even at the power level of pico-satellites. As this is a key satellite functionality, for each TIM satellite 6 reaction wheels will be onboard. In order to correct orbit deviations and to keep the formation, an electric propulsion system using FEEP technology (Field Emission Electric Propulsion) is used. Here with the precursor mission UWE-4, launched December 2018, the related technologies have already been demonstrated in orbit.

The attitude and position determination will be based on GNSS data (from GPS and Galileo systems), star sensors, gyros and on measurements from the intersatellite radio links. By a Kalman filter these data will be fused to provide the inputs to the distributed control algorithm, coordinating the cooperative photogrammetric observations.

For a planned launch at end of 2020, crucial technologies are currently implemented and tested by hardware-in-the-loop simulations using high precision turntables, providing promising performance results.