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TOWARDS PICO-SATELLITE FORMATION FLYING: THE UWE-3 IN-ORBIT EXPERIENCES

Abstract

Networked distributed systems promise interesting performance at small mass for terrestrial computer information processing as well as for satellites. The University Würzburgs Experimental satellite (UWE) program uses a step by step approach to develop and test in space the crucial technologies for formation flying at minimum necessary mass.

So far all UWE satellites were realized at a 1 kg mass level. While UWE-1 (launched 2005) characterized communication with internet protocols, UWE-2 (launched 2009) addressed attitude and orbit determination by sensor data fusion from MEMS inertial sensors, magnetometers, and sun sensors. Since November 2013 UWE-3 is in orbit to demonstrate attitude control. This contribution addresses the UWE-3 miniature attitude control system (ACS) technology implementation, based on six magnetic torquers and one very small reaction wheel. The in-orbit experiences related to detumbling, to slew maneuvers and to pointing performance will be presented and interpreted with respect to its relevance for coordinated measurements by a formation.

With respect to system design, the modular realization of UWE-3 will be emphasized forming the basis for the future multi-satellite formation realization. The classical cable tree is replaced by a backbone, where all data transfer and power lines are integrated. Thus the different subsystems are placed on specific boards connected via standardized pins with the backbone. Even late before launch this way complete subsystems can be flexibly exchanged.

After the ongoing implementation of UWE-4, addressing orbit control by an electric propulsion system on basis of vacuum arc thrusters, the crucial components and technologies for realizing pico-satellite formations will be in place. The application perspective for the four satellite formation flying mission composed of UWE-5 to UWE-8 is outlined. Multi-point measurements will here allow 3D-characterisation of the upper ionosphere.