

Autonomous Reaction Capabilities for Networked Control of Cooperating, Distributed Small Satellites

Klaus Schilling

Chair Informatics VII: Robotics & Telematics

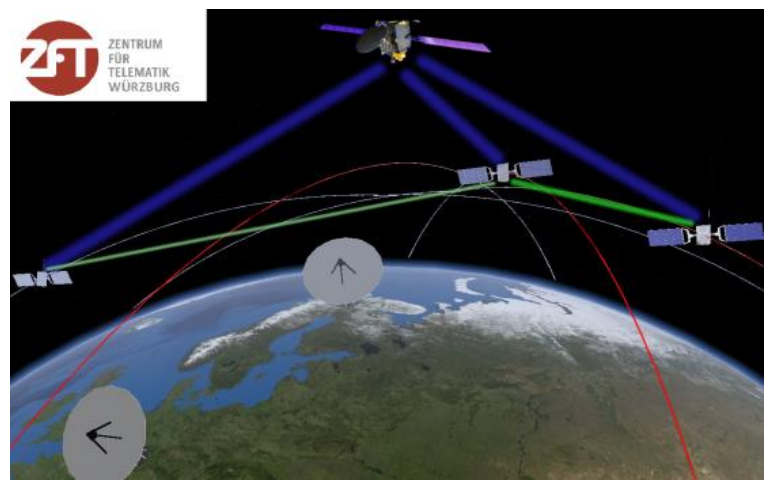
Julius-Maximilians-University Wuerzburg, Germany

schi@informatik.uni-wuerzburg.de

Formations of satellites require challenging autonomous reaction capabilities in order to coordinate attitude and orbit control for joint activities in Earth observation and telecommunication applications. For pico-satellites at a mass of a few kg modern miniaturization technologies enable surprising performance and support realization of robust, cost-efficient small satellites. In particular growing capabilities in attitude and orbit control allow to realize sensor networks of detectors composed of pico-satellites. In combination with sensor data fusion, innovative application approaches to Earth observation and communications are enabled.

The University Würzburg's Experimental satellite (UWE) program developed the crucial technologies for formation flying at minimum mass. UWE-1 was launched 2005 as first German pico-satellite (at 1 kg). Meanwhile all crucial technologies related to communication, to attitude determination and control were demonstrated in orbit. Robustness was achieved by an advanced fault detection, isolation and recovery (FDIR) software.

The application potential is illustrated by mission QUBE for secure communication using quantum technologies and optical links, as well as the pico-satellite formation flying missions "NetSat" composed of four satellites and "TOM – Telematics earth Observation Mission", being in implementation stage at the research company ZfT.



Prof. Dr. Schilling had in space industry responsibility in Earth observation and interplanetary satellites (such as HUYGENS to the Saturnian moon Titan and ROSETTA for exploration of comets, where adaptive control technologies were applied to handle uncertainties), before he was appointed professor and chair for Robotics and Telematics at University Würzburg. In parallel he is president of the research company „Center for Telematics (ZfT)“. His team built the first German pico-satellite UWE-1, launched 2005 to optimize Internet in space. He published more than 350 papers and received several awards, including the Walter-Reis-Award for Robotic Innovations 2008 (in mobile robotics) and 2012 (for medical robotics), as well as an ERC Advanced Grant for research on control of networked distributed satellite systems. He is full member of the International Academy of Astronautics and was Consulting Professor at Stanford University 2002-2006. In IFAC (International Federation on Automatic Control) he serves as Coordinating Chair for the area “Computers & Control”, after having been TC chair for „Telematics: Control via Communication Networks“ and for “Aerospace”.

