Interdisciplinary Project
Development of a Modular Attitude Determination and Control System Software for Small Satellites

Topic

Satellites often require an active attitude determination and control system (ADCS) to fulfill the mission requirements. For instance, the camera of an Earth observation satellite should point towards the Earth. Very high pointing requirements may be necessary to take very accurate pictures from the Earth’s surface. Space missions can require different implementations of the ADCS: Mission-specific pointing modes, control algorithms, actuators and sensors.

This interdisciplinary project aims to design an ADCS that can be used for different missions. One big challenge is the development of the ADCS software. Main goal is to derive a modular and extendable software implementation that can be adapted for different mission requirements. The following figure shows a compact overview of the most relevant components of an ADCS software.
Different sensors, such as sun sensors, magnetometers or gyroscopes are preprocessed and are fused in an Extended Kalman Filter (EKF) to estimate the satellite’s attitude in space. A guidance module provides the desired attitude of the satellite. Different attitude controllers can be used to compute the required control torque to track the desired attitude. Depending on the utilized actuators of the satellite (magnetic torque rods, propulsion system or reaction wheels), the desired control torque must be allocated and post-processed.

**Areas of Focus**

- **Software Design**: To fulfil the idea of modularity, the required modules for the software must be carefully designed.
- **Software Implementation**: The designed modules shall be implemented in C/C++. This can be the fusion algorithm, the controllers or any other important part of the software.
- **Testing**: The implemented software modules should be integrated into the simulation framework and tested with a software-in-the-loop approach.
- **Documentation** of the work

**Requirements**

- Good experience in C/C++ and git necessary
- Experience in control and estimation theory helpful, but not required
- Interests in embedded systems, space and satellites

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**Point of Contact**

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