University of Stuttgart
Collaborative Research Center 1667 ATLAS

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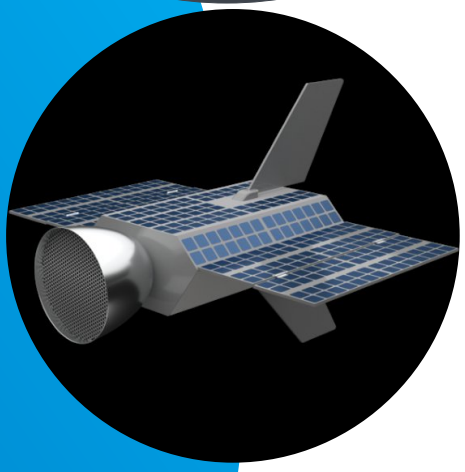
Development of a Flight Dynamics System for VLEO Satellite Operations Using Orekit

Bachelor / Master Thesis

Opportunity

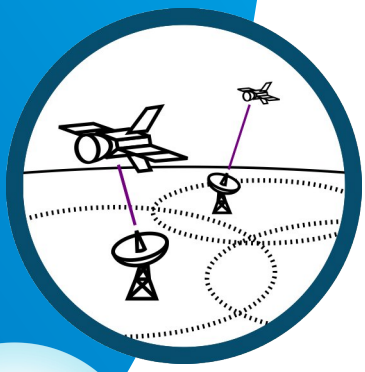
The collaborative research center (CRC) "Advancing Technologies of Very Low Altitude Satellites (ATLAS)" at the University of Stuttgart, funded by the German Research Foundation (DFG), addresses the fundamental scientific and engineering challenges of rendering Very Low Earth Orbit (VLEO) accessible and extending satellite lifetime by an order of magnitude. As part of this research project, the fundamentals of VLEO satellite operations are being investigated by drawing on expertise gained from operating satellites at the University of Stuttgart.

The aim of this thesis is to identify the requirements for a Flight Dynamics System (FDS) capable of supporting VLEO satellite operations. A FDS is used to pre-plan and support satellite missions by propagating the orbit based on GPS or Two-Line Element (TLE) data. Within an automated operations pipeline, the FDS provides orbit predictions and calculates pass schedules over available ground stations. While the existing FDS at the University of Stuttgart was developed for Low Earth Orbit (LEO) missions, the conditions in the VLEO regime differ significantly due to higher atmospheric density and increased drag variability. These factors require the implementation of more accurate physical models, improved numerical propagation algorithms, and a software architecture suitable for automation and operational use. This thesis focuses on developing a new FDS using the library Orekit and defining a modular and automation-capable system architecture.



Your tasks

- Familiarization with the existing FDSs and their current architecture
- Investigation of VLEO environmental influences and their effects on orbit propagation accuracy
- Research and comparison of FDSs used in previous or ongoing VLEO missions
- Evaluation and integration of advanced models within an Orekit-based simulation environment
- Analysis on the sensitivity of VLEO orbit propagation and measures to improve the accuracy
- Design of a modular and automation-ready architecture
- Documentation



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