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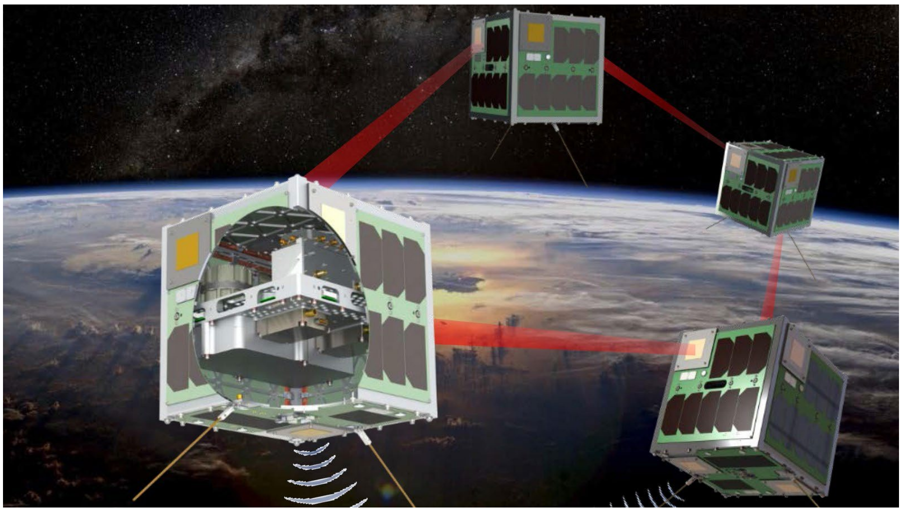
Master Thesis Announcement

Erarbeitung einer robusten Auswerteroutine von In-Orbit-Demonstrationen der Bahnregelung über Aerodynamik

Development of a robust evaluation routine for in-orbit demonstrations of orbit control via aerodynamics

Using several small, unconnected, co-orbiting satellites rather than a single monolithic satellite has many advantages. However, due to the tight volume and mass constraints of CubeSats, other solutions than using chemical and/or electric thrusters to withstand given natural perturbations and/or to perform reconfiguration maneuvers are of high interest. In VLEO, atmospheric forces are a possible solution for propellant-less relative motion control. At the Institute of Space Systems (IRS), this methodology has been actively researched since 2018 and a research cooperation with the Technical University of Berlin was established in 2023. Here, first in-orbit experiments targeting active drag modulation have been conducted with the 1U CubeSat "BEESAT-4". In a subsequent step, the knowledge and experience gained from this project are to be used to carry out an in-orbit demonstration of formation flight maneuvers based on differential drag using the S-NET formation. S-Net is a nanosatellite project of the TU Berlin which aimed at investigating and demonstrating the inter-satellite communication technology within a distributed and autonomously operating nanosatellite network. The mission consists of four 9U CubeSats which were launched in a 580 km SSO in 2018. The task of this master's thesis is the development of a robust evaluation routine for in-orbit demonstrations of orbit control via aerodynamics. This comprises both possible application scenarios, namely absolute and relative motion control. It shall be differentiated between the different forms of satellite navigation, i.e. global navigation satellite systems (GNSS), two-line elements (TLEs) or possibly even the signal run time of the S-band radio (e. g. for S-NET). To do so, BEESAT-2/4/6, S-NET and NanoFF will serve as concrete example use cases. In a subsequent step, the implications of the type of navigation on the manoeuvre design will be studied and conclusions drawn. Finally, the results shall be properly documented.



https://www.dlr.de/de/aktuelles/nachrichten/2018/1/20180201_s-net-neues-netzwerk-aus-nanosatelliten_25914

Task description of the Master thesis work:

- Familiarization with the methodology of (differential) aerodynamic forces;
- Familiarization with satellite navigation;
- Development of a robust evaluation routine for in-orbit demonstrations for both navigation types;
- Assessment of the implications of the type of navigation on the manoeuvre design;
- Critical assessment of the results and documentation.

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