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Master thesis announcement

Modellierung von GPS-Sensor Signalen und Implementierung des Konzepts des differentiellen GPS zur Relativnavigation von Satelliten

Modeling of GPS-sensor signals and implementation of the concept of differential GPS for the relative navigation of satellites

Motivation:

Differential aerodynamic forces are a promising option to control the relative motion of satellites which are not equipped with dedicated thrusting devices. At the IRS, the methodology is actively researched since 2018 and high-fidelity maneuver sequences which are robust towards uncertainties in the available control forces are under development.

Especially in the case of Cube- and NanoSats, one of the methodology's main target group, the accuracy of the available absolute and relative states estimation concepts is limited. So far, however, no assessment of the impacts of relative state estimation errors on differential drag and lift controlled maneuvers is available in literature. To address this research gap, it is foreseen to assess the influence of navigation errors on the maneuver outcome.

Within this thesis, the framework to realistically model GPS-sensor signals (including errors such as ionospheric effects, broadcast ephemeris errors and sensor noise) shall be developed in MATLAB®. In a successive second step, the concept of differential GPS shall implemented and used to estimate the relative states of satellites flying in formation. The goal of the work is to implement all necessary features to enable the accurate and realistic modelling of GPS-sensor signals as well as of the relative navigation of different satellites using differential GPS.

Tasks:

- Familiarization with satellite formation flight, GPS-based satellite navigation and the concept of differential GPS.
- Identification of options to accurately model GPS-sensor signals / errors.
- Implementation of the identified GPS-sensor signal / error models in MATLAB®.
- Implementation of the concept of differential GPS for the relative state estimation in MATLAB®.
- Verification of the model implementations.
- Documenting the findings in a structured report.

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