University of Bremen

CENTER OF APPLIED SPACE TECHNOLOGY AND MICROGRAVITY
ZARM

Master project

Satellite mission simulation of the geodetic satellites CHAMP, GOCE, LAGEOS with focus on non-gravitational force modeling

The precise non-gravitational force modeling is a perquisite for many tasks related to orbit determination and propagation, mission assessment and performance analysis. Especially for scientific missions (altimetry, geodesy, general physics, as well as GNSS) highly accurate models are very important.

Within a DLR project we compute atmospheric density data from GRACE/-FO orbit and accelerometer data. These kind of data are actually the most accurate data source for the thermosphere and will help to develop new empirical atmosphere models and validate more physic based models. We want to apply the same methodology to the geodetic satellites CHAMP and GOCE which are at different altitudes and cover different epochs. A main step to do this is to model the non-gravitational forces acting on the satellites.

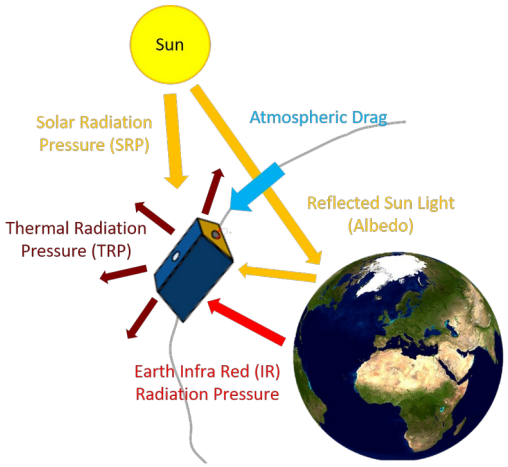


Figure 1: Non-gravitational accelerations acting on a satellite.

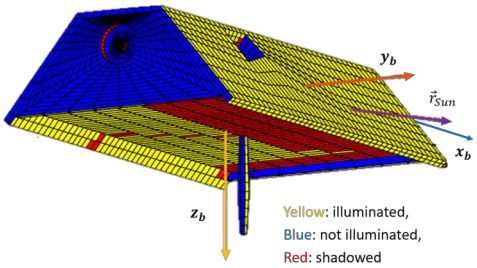
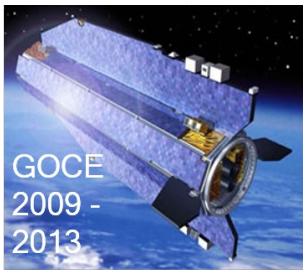


Figure 2: Finite element model of a GRACE-FO satellite for the radiative non-gravitational force computation.



Besides atmospheric drag, non-gravitational forces are mainly due to radiation of the Sun (SRP), reflected Sun light at the Earth (Albedo), Earth infra red radiation (IR) and thermal radiation of the satellite itself (TRP), see Fig. 1. The non-gravitational force models are implemented in our MATLAB/Simulink orbit and satellite simulation toolbox XHPS (eXtended Hybrid simulation Platform for Space systems) based on detailed Finite Element (FE) Models (eg. Fig.2).

Main tasks are:

- Development of detailed Finite Element (FE) models of the satellites (like in Fig.2 for GRACE-FO) and validation of the effects for different levels of detail.
- Implementation of a data processing and screening to use the real satellite data. Position and attitude data for the simulations and accelerometer data for validation

- Set up non-gravitational force simulations and development of automatic processing over longer times.
- Comparison and validation of simulation results with satellite accelerometer data.

The exact work schedule can be discussed in a personal meeting, depending on preferences and type of the thesis.

We are looking for students with:

- Background in physics or space engineering, preferably with programming skills and basic knowledge of orbital mechanics
- Interested in satellite data evaluation, processing and simulation

We can offer:

- Interesting topics in the field of satellite simulation, force modeling, orbit and gravitational field determination and analysis of satellite data
- Close scientific supervision and integration in our research group (Space Science, MSAMM, Benny Rievers)

A thesis is possible in **English** or **German**. If you are interested you are welcome to contact us for further information and/ or send us an application.

This topic could also be adapted to a Master or Bachelor thesis

Contact:

Florian Wöske: florian.woeske@zarm.uni-bremen, Moritz Huckfeldt: moritz.huckfeldt@zarm.uni-bremen