Master thesis:
Development of a lunar albedo and solar eclipse model with exemplary application to the GRACE/-FO satellites

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.

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). The non-gravitational force models are implemented in our MATLAB/Simulink orbit and satellite simulation toolbox XHPS (eXtended Hybrid simulation Platform for Space systems).

We want to add a model to consider the effect of reflected Sun light at the Moon and include the effect that a satellite might be in the shadow (umbra, penumbra, antumbra) of the Moon additionally to the shadow of the Earth.
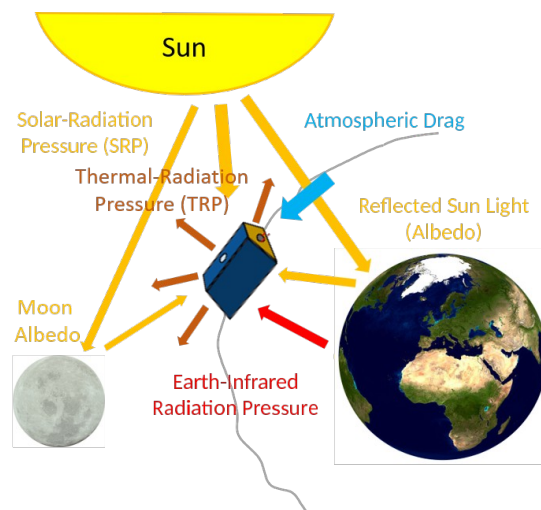

Figure 1: Non-gravitational accelerations acting on a satellite, including moon albedo

Thus, the task is to develop new models for illumination conditions of satellites due to eclipses from the Earth and the Moon as well as the radiation acceleration due to solar radiation reflected at the moon, similarly to the Earth albedo. The models are to be implemented in our XHPS toolbox. Subsequently the effects should be investigated with a specific mission simulation scenario for GRACE/-FO to investigate the frequency and intensity of the two effects. This includes literature research of the topic, development of all necessary algorithms, implementation in MATLAB, data analysis and characterisation of the impact of the effects on a satellite compared to other non-gravitational forces and effects.

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 Bachelor thesis.

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