University of Bremen

CENTER OF APPLIED SPACE TECHNOLOGY AND MICROGRAVITY

ZARM

Master thesis

Dynamic Precise Orbit Determination (POD) with Satellite Laser Ranging (SLR) with application to LAGEOS and GRACE

Dynamic POD is used to determine orbits or positions of satellites based on various observation data. Furthermore, it is possible and widespread to determine additionally parameters of force models of all kinds. Observation data might be data with respect to other satellites like GNSS data or inter-satellite ranging, as well as measurements from ground like ranges or angles. A prominent technique is Satellite Laser Ranging (SLR), giving ranges between a SLR station and a satellite at distinct times.

In our working group we use dynamic POD mainly with GNSS data to determine force model parameters and a kind of extended POD (it is then rather called Gravity Field Recovery - GFR) to determine the gravitational field of the Earth and its changes. We do this with real satellite data from dedicated missions like GRACE/-FO and with completely simulated mission scenarios for performance analysis.

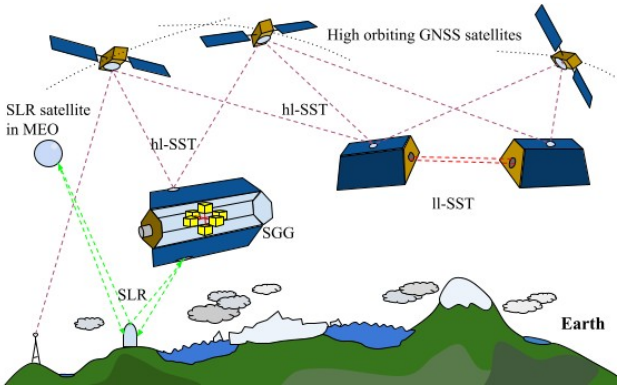

Figure 1: Different satellite observation data for POD and GFR and concepts based on these observations. SST Satellite-to-Satellite Tracking, hl: high-low, ll: low-low

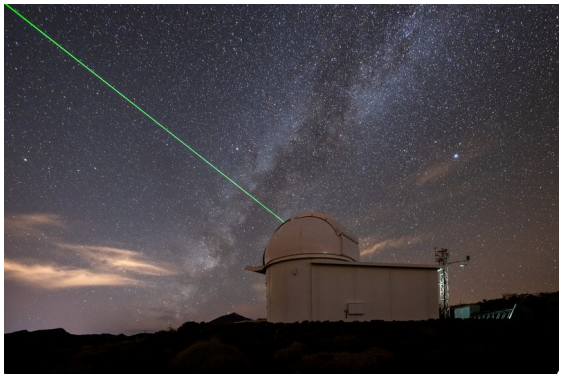

Figure 2: Satellite Laser Ranging (SLR) station (@ESA)

We would like to add SLR observations in our POD and utilize the available database of tracked satellites. Hence the main tasks are

- Implementation of SLR observations in the POD scheme
- Validating available SLR data and utilizing it in the POD

Some subsequent application of the developed functionalities could be

- Validation of force models and instrument calibrations for GRACE/-FO with SLR based POD
- GFR of low degree gravitational field coefficients with “SLR-satellites” (spherical satellites like LAGEOS). This would also require to compute the non-gravitational forces acting on such satellite with the models implemented in our XHPS (eXtended Hybrid simulation Platform for Space systems) simulation tool.

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 good knowledge of orbital mechanics
- Interested in satellite data evaluation, processing and simulation
- No fear of some satellite related mathematical estimation theory

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 project with maybe two people.

Contact:

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