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SATELLITE GEODESY MISSION PREPARATION USING SATELLITE FORMATION FLIGHT SIMULATOR - XHPS

Abstract

The eXtended High Performance satellite dynamics Simulator (XHPS) is being developed for achieving the long-term / general goal of characterizing and evaluating the performance of space-based geodetic measurement systems.

This will be achieved by using a high-precision modular approach and a complete implementation of interactions between satellite platform, payload, environment and mission profile. The interior and the exterior of the satellite is modeled with finite element method which enables the simulator to compute complex interactions, e.g. multiple reflections, environmental disturbances, and temperature distributions. The involved methods have strong generic characteristics and are applicable to a broad range of satellite geodesy mission layouts.

For future missions, we foresee following complex and challenging tasks:

1. ensuring the numerical precision that is needed to analyze, e.g. nano- or picometer ranging sensor accuracies,
2. understanding and modeling the interaction of sensor errors and system related errors in the multi-sensor system,
3. and understanding the environmental laboratory conditions to achieve this unprecedented level of accuracy

Thus, XHPS is designed to handle the dynamics computation in multi-precision above the conventional double data type on top of the aforementioned generic approach. Ultimately, XHPS enables researchers and experts to evaluate the performance of new measurement systems and sensors, to compare different mission concepts and to identify means of optimization with a full-scale implementation of the system as a numeric model.

This contribution introduces the application of XHPS to the upcoming GRACE Follow-On mission, where the simulator is planned as the basis for the generation of mock data sets prior to its launch in 2018. The numerical mock up of GRACE Follow-On with sophisticated attitude control system is implemented in the simulator to generate realistic laser ranging interferometer measurements. The whole chain of the process to recover the gravity field from the simulated observation will be illustrated and summarized with example results.