UNIVERSITÄT BERN

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Master Thesis

Maneuver Modeling for Precise Orbit Determination of Low Earth Satellites

MOTIVATION

The Sentinel-1A satellite, ESA's first satellite of a new fleet of Earth observation satellites belonging to Europe's Copernicus programme, was launched on April 3, 2014 into a sun-synchronous orbit. It is equipped with an 8-channel, dual-frequency Global Positioning System (GPS) receiver used for precise orbit determination (POD) and geolocation of the radar instrument to provide an all-weather, day-and-night supply of imagery of the Earth's surface. Sentinel-1A precise orbit solutions are computed by the Astronomical Institute of the University of Bern (AIUB) during the entire mission in the frame of ESA's Sentinel POD Quality Working Group (QWG). Sentinel-1A POD is complicated by the fact that orbit control maneuvers are performed relatively frequently. Orbit control of is done in a 120 m ground-track control-band at the equator (in-plane maneuvers) and at maximum latitude (out-of-plane maneuvers). As a consequence 1 to 2 in-plane maneuvers are performed every 14 days and 6 to 8 out-of-plane maneuvers every year.

DESCRIPTION

- Maneuver information (burn start and stop times, components of the performed acceleration) are provided as auxiliary information in the frame of the Sentinel-project. As a first step of this Master thesis this information shall be incorporated and validated within the Bernese GNSS Software to also enable Sentinel-1A orbit determination on maneuver days. Use can be made of existing procedures for automated Sentinel-1A POD.
- In a further step of sophistication the maneuver handling shall be improved by estimating corrections from the GPS data to the a priori known information of the performed accelerations. Several parametrizations such as instantaneous velocity changes or piecewise constant accelerations may be tested and an optimal maneuver handling shall be established for Sentinel-1A POD.

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