Geophysical Research Abstracts
Vol. 18, EGU2016-16142, 2016
EGU General Assembly 2016

On the feasibility of phase only PPP for kinematic LEO orbits

Christoph Wallat and Steffen Schön
Leibniz Universität Hannover, Institut für Erdmessung, Hannover, Germany

Low Earth Orbiters (LEO) are satellites in altitudes up to 1000 kilometers. From the sensor data collected on board the Earth's gravity field can be recovered. Over the last 15 years several satellite missions were brought into space and the orbit determination improved over the years. To process the sensor data, precise positioning and timing of the satellite is mandatory. There are two approaches for precise orbit determination (POD) of LEO satellites. Kinematic orbits are based on GNSS observations and star camera data measured on board of the LEO. With a Precise Point Positioning (PPP) known from the terrestrial case, using ionospheric-free linear combinations P3 and L3 three-dimensional coordinates of the LEO can be estimated for every observation epoch. To counteract the challenges in kinematic orbit determination our approach is based on a technique called GNSS receiver clock modeling (RCM). Here the frequency stability of an external oscillator is used to model the behavior of the GNSS receiver clock with piecewise linear polynomials instead of estimating epoch-wise the receiver clock time offset as an unknown parameter. When using RCM the observation geometry is stabilized and the orbit coordinates and the receiver clock error can be estimated with a better precision.

The satellites of the Gravity Recovery And Climate Experiment (GRACE) mission are equipped with Ultra Stable quartz Oscillators (USO). The USO frequency stability is used to correct the GRACE GPS receiver clock. Therefore, receiver clock modeling is feasible for polynomials with a length up to 60 seconds, leading to improved mean PDOP values of 30 % and smaller formal mean standard deviations of the coordinates between 6 and 33 %. We developed a new approach for GRACE orbits using kinematic PPP with clock modeling and tested our approach with simulated and real GPS data. The idea to use only carrier phase observations in the final processing and no code measurements leads to a reduced number of observations and changes in parameter correlation in the adjustment. Canceling the code observations out of the normal equation system is possible due to a technique named parameter lumping, which will be explained in detail. The estimated coordinates of our phase only approach are comparable to the conventional PPP solution concerning standard deviations and RMS values. We will point out the advantages of our approach for the kinematic orbit determination of the GRACE satellites also for improvements in computing phase ambiguities.