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Geometrical LEO Precise Orbit Determination (POD) with only sequential time differenced GPS SST carrier phase observations

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High-low GPS LEO (Low Earth Orbiter) SST (Satellite to Satellite Tracking) observations play an important role to determine geometrical, precise, 3D orbits of LEO satellites. The ambiguity parameters in the Zero difference technique aren't integer any more, and the carrier phase observations have to be solved in the float mode. If the difference between two sequential epochs has been built, and the observation rate is small then on the one hand, the ambiguity parameters have been canceled out (if there aren't any cycle slips in the carrier phase observations), on the other hand many errors in the ZD observations can be eliminated (e.g. antenna phase centre offsets and its variations, multi-path, etc.). Therefore, the sequential time differenced carrier phase observation has been proven to be very efficient for the LEO precise orbit determination. In this paper, as a first step to determine geometrical LEO precise orbits, initial LEO absolute positions have been estimated based on the Bancroft method with an accuracy of a few meters. These absolute positions can be used subsequently as initial values for LEO positions based on pseudo-range ionosphere free observations. To avoid cycle slips in the carrier phase observations, at first, 15 elevation cut-off angle has been applied to the observations, secondly, with the estimated positions in the code pseudo-range process and with the help of the receiver clock offset between two sequential epochs, the cycle slips have been eliminated in the iterative process. It is clear that in this method, the estimated LEO orbit is point-wise (geometrical, not kinematical) and the geometrical configuration (DOP) of GPS satellites plays an important roll in the data processing. This method has been tested with simulated data (SC7 - Special commission 7), which are available from the homepage of the Institute for Geodesy and Geo-information of the university Bonn, (www.geod.uni-bonn.de), and with real

LEO data (CHAMP & GRACE) from GFZ, Potsdam, Germany.