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GPS Precise Point Positioning Techniques for Estimating Topside Ionospheric Total Electron Content using CASSIOPE GAP Measurements: Update

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The Canadian CAScade, Smallsat and IOnospheric Polar Explorer (CASSIOPE) small satellite Enhanced Polar Outflow Probe (e-POP) payload includes the GPS Attitude, Positioning, and Profiling zenith-facing GAP-A antennas and associated dual-frequency GPS receivers, which can be utilized to derive estimates of total electron content (TEC) above the satellite. These TEC estimates can be used to improve the spatial resolution of current ionospheric plasma density determinations through densification of existing datasets used to generate various ionospheric models, with the current work focused especially in polar regions.

To provide these estimates, a specialized precise point positioning (PPP) software package is being developed to post-process the raw carrier-phase and pseudorange observables obtained from three of the four GAP-A GPS receivers. This new software package makes use of both the standard uncombined PPP and array-aided PPP (A-PPP) techniques. As the A-PPP TEC estimation technique requires data from multiple, collocated antennas with known, fixed-baseline offsets, the GAP-A receivers/antennas are particularly well suited. The A-PPP technique provides more robust TEC estimates through use of parameter constraints within the least-squares algorithm associated with the use of collocated antennas.

The original software design relied on float ambiguity estimation and utilized a slightly-modified version of the cycle-slip correction algorithm outlined by Banville and Langley [1]. However, after extensive testing, it was determined that this approach was not suitable for use with low Earth orbit (LEO) GPS receiver data due to the inherent high receiver dynamics and multipath of this orbit type. Therefore, the processing software is being rewritten to include ambiguity resolution in order to provide more robust TEC solutions, capable of handling the variable ionospheric activity, receiver dynamics, and multipath of GPS data obtained using a LEO satellite.

We will provide a status report on the project, which is supported by the Canadian Space Agency and the Natural Sciences and Engineering Research Council of Canada.

1. S. Banville and R. B. Langley, “Instantaneous Cycle-slip Correction for Real-time PPP Applications,” *Navigation*, **57**, 4, 2010, pp. 325-334, doi:10.1002/j.2161-4296.2010.tb01786.x.