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Real-time PPP with undifferenced integer ambiguity resolution, experimental results

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A method to solve the GPS zero-difference measurement equations with integer ambiguities has been recently introduced at CNES. When the method is applied to data from a global network of GPS receivers it provides a consistent set of satellite orbits and clocks, which have an 'integer' property: phase residuals for any receiver computed using these orbits and clocks easily reveal integer ambiguities.

The presentation focuses on the application of this novel approach to the computation of real-time orbits and clocks for the GPS constellation, and the benefit of using these products for real-time Precise Point Positioning (PPP) with integer ambiguity fixing of user receivers.

In this method, real-time corrections to extrapolated IGS IGU orbits are estimated at the same time as all other relevant parameters by a Kalman filter which processes measurements from a world-wide stations network. The filter performs zero-difference ambiguity fixing in real-time. Two results are presented; the first with one month of raw data taken from the IGS, the second with raw data taken from the Internet in real-time using the NTRIP protocol. Relative to IGS final orbits, the 3-D precision of the real-time orbits is about 3 cm RMS.

When these constellation orbits and clocks are used to perform real-time PPP for receivers outside of the reference network, the horizontal precision obtained using zero-difference integer ambiguity fixing is close to 1 cm RMS. This is about one order of magnitude better than standard solutions, which rely upon floating ambiguity fixing, close to the precision of RTK. We present several 'site survey' type real-time experiments conducted at CNES that confirm these results.

Advantages and drawbacks of this new integer-PPP method with respect to RTK are outlined. These topics include mainly the time to convergence, the baselines size and the associated precision. Some specific applications of this new method, especially those that cannot be obtained using a standard RTK method are proposed.

Finally, ongoing and future work conducted at CNES on real-time applications is outlined. This work concerns mainly the development of a real-time integer PPP demonstrator. The goal and architecture of this demonstrator is presented, as well as the current development state and some preliminary results.