A Comparison of IPPP GNSS Solutions for Time and Frequency Transfer

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GNSS-based time and frequency transfer is the most commonly used technique for worldwide clock comparisons.

In the last few decades, Precise Point Positioning (PPP) has become one of the de facto standards for GNSS precise time transfer. Furthermore, over the last years, GPS PPP with Integer ambiguity resolution (IPPP) has pushed the performance of GNSS time transfer even further, approaching 1e-17 frequency transfer capabilities with long averaging.

IPPP using constellations other than GPS (GALILEO and BDS) is now routinely performed in the geodetic and positioning community and might be exploited for time transfer too.

In this contribution, we show a comparison of the PPP solutions with integer ambiguity resolution for GPS, GAL and BDS used for time and frequency transfer over a wide range of UTC(k) links. The results are computed using four independent IPPP solutions with different PPP software: Atomium, GINS, goGPS, and SPARK.

After a brief introduction of the four different processing techniques, we will show the results of the processing using data from different UTC(k) links over a few months. The considered baselines will range in length from a few hundred kilometres to intercontinental links.

Different combinations of GNSS and receiver types will be presented. Also, common clock receivers will be used to characterise the impact of different receiver hardware and/or hardware delays.

For some short baselines, the resulting time differences will also be compared against fibre optic two-way time and frequency transfer data. For instance, Fig 1 and 2 reports a comparison of the IPPP solution with the GUM-AOS fibre links data reported in a continuous way to the BIPM.

The evaluation will highlight the time bias, frequency bias, and frequency stability of the solutions.

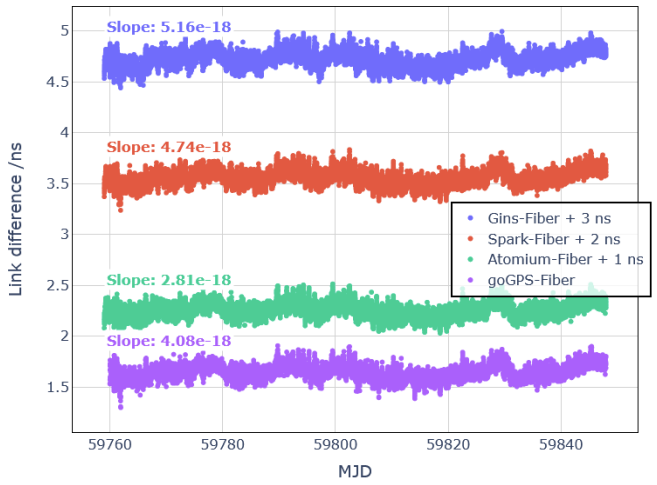

Fig1. AOS-GUM link difference between IPPP solutions and fiber optic data.

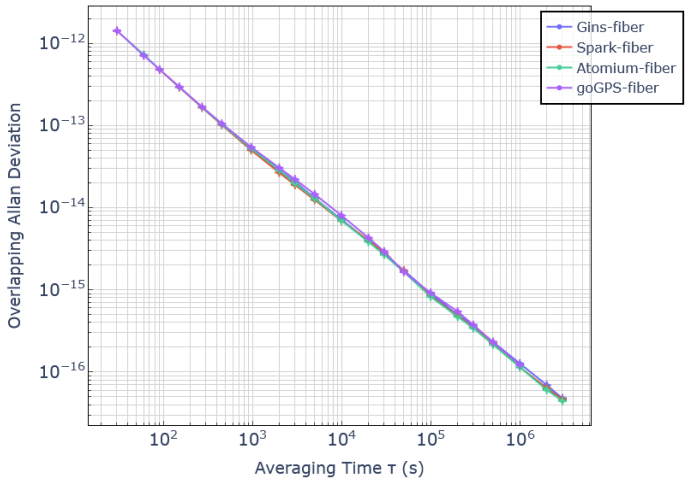

Fig 2. Overlapping allan deviation of the difference between the IPPP solutions and the fiber optic data.