Analysis of the Code / Phase Behavior in the GPS-iPPP Time Transfer

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Comparison of remote clocks is mainly based on radio frequency technologies such as GPS or TWSTFT. More recently, optical technologies have emerged, either in free propagation (T2L2) or via optical fibers. These optical technologies promise time transfer with sub nanosecond uncertainty. However, these performances need to be assessed by comparison with proven systems.

TWSTFT Phase being still experimental, GPS Carrier Phase techniques are those with the greatest potential for comparison with optical links. However, the processing of GPS phase signals requires establishing specific mechanisms to reduce ambiguities. Several techniques exist[1], which ensure continuous solutions in phase. However, if these solutions are satisfactory for the frequency transfer, they are not absolute and do not guarantee the accuracy of the time transfer.

In a previous study[2], we explored different methods of adjusting the phase on the code of the GPS signal in an attempt to improve the accuracy of GPS Carrier Phase time transfer. If the results did not allow validating the method, they showed an unexplained behavior of code / phase solutions (drift?). In this study, we propose to further explore the behavior of the Code and Phase solutions of the GPS time transfer using single-difference (and zero-difference) integer ambiguity resolution method[3] by studying the influence of processing's parameters as well as the receivers' type or geometry of the links.

[1] D. Laurichesse et al, "Integer Ambiguity Resolution on Undifferenced GPS Phase Measurements and Its Application to PPP and Satellite Precise Orbit Determination", Journal of the Institute Of Navigation, pp 135-149, Vol. 56 N° 2, 2009

[2] Ph. Guillemot et al., "Combination of T2L2 and GPS-CP data : Towards an improvement of Time Transfer Accuracy", proc. IEEE-UFFC/EFTF, 2013.

[3] J. Delporte et al., "GPS Carrier-Phase Time Transfer Using Single-Difference Integer Ambiguity Resolution", International Journal of Navigation and Observation, Volume 2008 (2008), Article ID 273785.