Nonstationarities in space clocks: investigations on experimental data

A. Cernigliaro[2], G.Fantino[1], I. Sesia[1], L.Galleani[3], P. Tavella[1]

[1]National Institute of Metrological Research (INRIM), Turin, Italy
[2]aizoOn, Turin, Italy
[3]Politecnico di Torino, Turin, Italy

Email: i.sesia@inrim.it

Atomic clocks employed onboard satellites are one of the basic elements of Global Navigation Satellite Systems (GNSS). The positioning accuracy is highly dependent on these space clocks, whose stability is essential to ensure adequate performances. Monitoring and analyzing the behavior of space clocks is hence a fundamental task. Any nonstationarity, namely, any deviation of the clock behavior from the specifications, must be detected and communicated to the system users within a few seconds.

In this paper we analyze more than five years of public satellite clock data for GPS, GLONASS and Galileo, obtained from the Information Analytical Centre and the International GNSS Service, including the Multi-GNSS Experiment.We evaluate and compare the stability of the system clocks under stationary behavior, namely, when the clocks behave according to the specifications. Then we classify the most evident clock apparent anomalies and we analyze them with tools specifically designed for clock nonstationarities, such as the dynamic Allan variance. Our goal is to understand the nature of every type of nonstationarity, and, eventually, to build a statistics of the most frequent ones.