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Author: Mr. François Xavier Marmet
Centre National d'Etudes Spatiales, Toulouse, France, France

Mr. Jean-Paul Aguttes
Centre National d'Etudes Spatiales (CNES), France
Mr. jerome Maureau
Centre National d'Etudes Spatiales (CNES), France
Mr. Massimiliano Calaprice
Centre National d'Etudes Spatiales, Toulouse, France, France

# GPS/GALILEO NAVIGATION IN GTO/GEO ORBIT

**Abstract**

The development of electrically propelled geostationary platforms together with alternative strategies to reach geostationary orbit increase the interest for autonomous satellite localization and particularly GNSS navigation on high altitude orbits. It is known that GNSS navigation for GTO/GEO is much more difficult than in LEO since the GNSS receiver is often or permanently at an altitude greater than the altitude of the GNSS constellations making the GNSS signals drastically less available and weaker. This paper studies the GPS and Galileo navigation on GEO GTO and new GTO (i.e. GEO spiraling) orbits, which corresponds to new hypotheses compared to studies sometimes more than 15 years old. Moreover, the paper goes beyond the classical view point of GNSS geometrical visibility by analyzing also the "signal visibility" and showing the sensitivity of key GNSS receiver performances like acquisition, tracking, and demodulation thresholds. Comprehensive simulation results and analyses come along with a discussion of the operational benefits of using GPS and Galileo navigation. These data eventually sets the ground for a discussion of the key technical options (number and antenna types, Rx chain architecture, signal processing algorithm, orbital filter and signal acquisition assisting, number of GNSS frequencies ...). It is shown that using GNSS for GEO/GTO/newGTO orbits is feasible, even considering current spaceborne receivers state-of-the-art, and provides most of the acclaimed benefits of GNSS in LEO, among them more accurate spacecraft localization, precise onboard absolute time and increased autonomy. Finally the interest of upcoming first technological or operational missions flying GNSS receiver on high altitude is shown in term of feedback and risk reduction.