GEOLOCALISATION ET NAVIGATION
DANS L'ESPACE ET LE TEMPS

Investigations on TLE time series accuracy for GNSS satellites, over short and long-time scales

Florent Deleflie[1], Alexis Petit[2], Jérôme Daquin[3], Felix Perosanz[4], Michel Capderou[5]

[1]IMCCE / Observatoire de Paris / GRGS
[2]IMCCE / Observatoire de Paris
[3]RMIT Melbourne,
[4]GET, Observatoire Midi-Pyrénées / GRGS
[5]Michel Capderou, LMD, Ecole Polytechnique

The trajectory of GNSS satellites, and the visibility conditions from the ground, can be carried out from precise GNSS measurements, or from the well-known Two-Line Elements (TLE) provided by NORAD. Depending upon the purpose, the latency of the tracking data, the time available to derive the results, precise orbits (at the level of one-centimeter accuracy) or rough orbits can be propagated and delivered to the users, through a large set of various tools, some of them being publicly available. We propose in this paper to analyse the compatibility of different approaches and different initial conditions, propagated over very short (a couple of days) and very long (two centuries) time scales, applied to some satellites in the various GNNS constellations (GPS, Galileo, GLONASS, BeiDou).

GRGS (Groupe de Recherche de Géodésie Spatiale) is a French research group gathering up French scientists within different institutions focusing their activities to space data analysis, and in particular related to space geodesy and precise orbitography. Hence, GRGS is in charge of the French analysis center of GNSS data providing precise orbits of the GNSS satellites IGS, the International GNSS Service, as a component of the International Association of Geodesy. Using the time series of orbital elements built by GRGS is way to take benefit of the best possible accuracy to the tracking data.

As a first part of this presentation, we analyse over a couple of days the visibility conditions as scheduled from precise orbits and from TLE time series, that have the state of "mean elements », with an accuracy which is quantified though through formulas deriving osculating elements from mean elements and conversely. As a second part of this presentation, the stability of GNSS orbits is analysed over two centuries, to investigate from the TLE times series whether the future storage orbits are likely to be sensitive, or not, to deep resonance effects, by using the French STELA s/w designed in the framework of the French space operation act.