Geophysical Research Abstracts
Vol. 20, EGU2018-12644-1, 2018
EGU General Assembly 2018

Fully relativistic positioning for the Galileo for Science (G4S) project

Matteo Luca Ruggiero (1,2), Angelo Tartaglia (2), David Lucchesi (3), Giovanni Delle Monache (4), Roberto Peron (3), Elisa Rosciano (5), Francesco Santoli (3), Francesco Vespe (5), and Massimo Visco (3)

(1) INFN, Sezione di Torino, Italy (matteo.ruggiero@polito.it), (2) Politecnico di Torino, Dipartimento di Scienza Applicata e Tecnologia, Corso Duca degli Abruzzi 24 10129 Torino, Italy, (3) INAF, Istituto di Astrofisica e Planetologia Spaziali, Via del Fosso del Cavaliere 100 00133 Roma Italy, (4) INFN, Laboratori Nazionali di Frascati, Via Enrico Fermi 40 00044 Frascati Italy, (5) ASI, Centro di Geodesia Spaziale, Località Terlecchia 75100 Matera Italy

A fully relativistic positioning system is described, performing in practice a four-dimensional topographic description of space-time. The geometric ingredients used for reconstructing the space-time trajectory of an observer are null geodetics. The latter are physically realized by pulsating or periodic electromagnetic signals broadcasted from stations occupying fixed positions in a fiducial reference frame. Families of equal phase hypersurfaces corresponding to periodic pulses (or recurring phases of continuous emissions) cover the space-time manifold with four-dimensional cells. The world-line of a receiver to be localized intersects the walls of such cells; each intersection corresponds to the arrival of a pulse from a given source. The only measurement performed by the receiver is the proper time lapse between the arrivals. The acquisition of a sequence of such lapses, combined with the knowledge of the positions of the emitters, together with their proper emission periods of the pulses, allows the user to find its own space-time position by means of a simple linear algorithm. Everything is represented in a ground based reference frame; not less than four ground stations simultaneously visible from the satellites act as emitters of periodic pulses (or fixed frequency continuous waves). The emission must be stable and the position of the antennas must be given with geodetic accuracy, but synchronization of the emitters is not necessary. The lowest limit for the accuracy of the positioning depends on the stability and definition of the emission periods of the pulses and on the precision of the onboard clock used for measuring the intervals between the arrivals of successive signals. This method will be used in the Galileo for Science (G4S) project, presented elsewhere in this conference, in order to reconstruct the orbits of the two Galileo satellites 201 & 202 (DORESA and MILENA). The method is thought of as being complementary to other approaches, especially satellite laser ranging, having the advantage to attain the same accuracy in all directions. The purpose is to gather information on the gravitational and non-gravitational perturbations determining the time evolution of the eccentric orbits of the two satellites. In particular, the accurate reconstruction of the dynamics of the plane of the orbit will provide access to the gravito-magnetic field of the earth.