

## **INTEGRATING THE MOTION OF GEODETIC SATELLITES IN A COHERENT RELATIVISTIC FRAMEWORK.**

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Today, the motion of spacecrafts is still described according to the classical Newtonian equations plus the so-called «relativistic corrections», computed with the required precision using the Post-(Post-...) Newtonian formalism. The current approach, with the increase of tracking precision (Ka-Band Doppler, interplanetary lasers) and clock stabilities (atomic fountains) is reaching its limits in terms of complexity, and is furthermore error prone.

In the more appropriate framework of General Relativity, we study a method to numerically integrate the native relativistic equations of motion for a weak gravitational field, taking into account not only gravitational forces, but also non gravitational forces (atmospheric drag, solar radiation pressure, albedo pressure, thermal emission...).

When considering gravitational forces alone, the unperturbed satellite motion follows the geodesics of the local space-time. For the appropriate metric, the latter equations contain all the gravitational effects at the appropriate order. Indeed, with a Schwarzschild metric corresponding to the central body, we include the Schwarzschild precession. The central gravitational potential in the metric can be developed in spherical harmonics (planetary gravitational potential model) to include the gravitational multipole moment contributions to the satellite motion. With the corresponding Kerr metric, we add the Lens-Thirring precession. Finally, computing the geodesic equations for the Geocentric Coordinate Reference System metric (GCRS metric given by the IAU conventions 2000) with (or without) the Sun, Moon and planets will additionally take into account the geodesic precession with (or without) the gravitational perturbations due to other solar system bodies.

We further recommend the use a symplectic integrator to compute the unperturbed geodesic motion, in order to insure the constancy of the norm of the proper velocity quadri-vector.

Non-gravitational forces will be treated as perturbations, in the sense that we assume that the local structure of space-time (the metric) is not modified by these forces.

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