

# **The LAGEOS satellites orbital residuals determination and the way to extract gravitational and non-gravitational unmodelled perturbing effects**

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Long-arc analysis of the orbits of geodetic satellites is a useful way to extract relevant information concerning the Earth structure, as well as to test relativistic gravity in Earth's surroundings. The physical information is concentrated in the satellite orbital residuals, that must be extracted from the orbital elements determined during the precise orbit determination procedure. However, the physical information we are interested to, especially in the case of tiny relativistic predictions, is biased both by observational errors and unmodelled (or mismodelled) gravitational and non-gravitational perturbations (NGP). Indeed, the satellite orbital elements residuals represent a powerful tool to obtain information on poorly modelled forces, or to detect new disturbing effects due to force terms missing in the dynamical model used for the satellite orbit simulation and differential correction procedure. In the case of the two LAGEOS satellites orbital residuals, several unmodelled long-period gravitational effects, mainly related with the time variations of Earth's zonal harmonic coefficients, are superimposed with unmodelled NGP due to thermal thrust effects and the asymmetric reflectivity from the satellites surface. The way to extract the relevant physical information in a reliable way represents a challenge which involves, at the same time, precise orbit determination, orbital residuals determination, statistical analysis and modelling.