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The measurement of the general relativistic Lense-Thirring effect in the gravitational field of the Earth with artificial satellites

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The linearized approximation of the Einstein's General Theory of Relativity, valid for small velocities with respect to the speed of light c and for weak gravitational potentials with respect to c^2, predicts, among other things, that the node Ω and the perigee ω of a test particle freely orbiting a central rotating mass with proper angular momentum J undergo tiny secular precessions: it is the so-called Lense-Thirring effect. Up to now, the only performed attempts to measure it in the gravitational field of the Earth have been performed by analyzing suitable linear combinations of the residuals of the rates of such orbital elements of the existing LAGEOS and LAGEOS II satellites. Such combinations, which allow to cancel out the impact of the first even zonal harmonics, are $\delta\dot\Omega^{\rm LAGEOS}+0.295\,\delta\dot\Omega^{\rm LAGEOS\,II}-0.35\,\delta\dot\omega^{\rm LAGEOS\,II}$ and $\delta\dot\Omega^{\rm LAGEOS}+0.546\,\delta\dot\Omega^{\rm LAGEOS\,II}$. The reliability of the claimed total errors (20-25$\%$ and 5-10$\%$, respectively) in such tests is still rather controversial. The major source of systematic bias is represented by the aliasing effect of the classical secular precessions induced by the mismodelled even zonal harmonic coefficients J_ℓ of the multipolar expansion of the terrestrial gravitational potential. In this paper we will discuss this topic and we will propose an alternative linear combination involving the nodes of the LAGEOS satellites, of Ajisai and of Jason-1. It would allow, in principle, to overcome some of the possible sources of uncertainties which may affect the tests with the LAGEOS satellites.