# Numerical simulation of the LAGEOS thermal behaviour and thermal accelerations

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The dynamical modelling of the forces acting on the LAGEOS satellites is one of the most interesting issues in orbital dynamics. The level of detail of the modelled forces, reaches the value of a single $pm\ s^{-2}$. One of the most important contributors to the satellite dynamics comes from the so-called thermal forces. This study numerically simulates the temperature distribution throughout the LAGEOS satellites, with the objective to determine the resulting thermal force. The different elements and materials comprising the spacecraft, with their energy transfer, have been modelled with unprecedent detail. The radiation inputs on the satellites are: direct solar (eclipse modulated), Earth albedo, and Earth infrared radiations.

For each satellite the lifetime temperature (behaviour) of $2133$ nodes is computed. Based on this distribution, individual forces and the net instantaneous accelerations are obtained. Simulations yield typical temperature variations ranging between $30$ and $100\,K$ for different elements and materials, whereas the net instantaneous accelerations are in the order of $70\,pm\ s^{-2}$, in good agreement with previous results. Simulations also show the importance of the consideration of a proper orientation of the satellite: the LOSSAM spin-model yields acceleration differences of up to three times the acceleration obtained with a constant spin-axis orientation. The temperature of the four germanium retroreflectors deviates up to $70$ and $100\,K$ w.r.t. their silica counterparts for LAGEOS-I and II respectively. This generates thermal acceleration differences of several $pm\ s^{-2}$, up to $25\%$ of the postulated difference in reflectivity between the satellite hemispheres. Two factors play a major role: the spin rate and the Sun aspect angle w.r.t. the spin-axis. Based on the latter, two characteristic periods can be distinguished: a rapid-spin, slow-drift period (until $13$ and $8\ yr$ after launch for LAGEOS-I and II respectively) and a slow spin, rapid wobbling afterwards. The acceleration results will be used in a refined orbit computation in a subsequent investigation.