# On the motion and attitude of artificial satellites around the Earth

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**Résumé**

This lecture will be describing the main characteristics of the motion of spacecraft around the Earth. It will begin with a description of the main perturbations induced on the motion (of the center of mass) by the dynamical flattening of the Earth though a parameter called J2, characterizing the differences in the gravitational potential from the Earth equator to the poles. Then, the perturbations induced by non-gravitational effects will also be presented, as the effects of the atmospheric drag on low-altitude satellites. The amplitudes of those non-gravitational perturbations are driven by the area-to-mass ratio, than can change by several orders of magnitude according to the shape of the satellite. Moreover, in case of non-spherical satellites, the area-to-mass ratio can even be a time-dependant quantity, that makes the modelling of perturbations be even more complex. The rotation of artificial satellites around their center of mass will also be presented, through the description of the equations driving the temporal evolution of their attitude. The sources of perturbations include a widespread list of external gravitational and non-gravitational perturbations, including high-order gravitational accelerations, the gravity-gradient torque, third-body perturbations from the Sun and the Moon, aero-dynamic drag and torque, direct, Earth-emitted, and reflected radiation pressure and torque, the eddy-current torque, and internal energy dissipation. A rough order of magnitude of the effects induced on the motion by each of these perturbations will be provided as well.

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