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Rotation and libration of icy satellites

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The knowledge of the rotational motion is an important piece of information about the interior process of bodies and to understand the tidal response. Recently, trough the observations acquired by the space mission Cassini, the rotational motion of Titan, Janus and Epimetheus have been determined and for Enceladus, relationship between its librational motion and its jets have been suspected. The librations, which are variations around the uniform rotational motion, will present a wide spectrum of frequencies due to the orbital variations of the satellite. Two different timescales dominate the spectrum, long periods related to the motion of the nodes of the orbit and short periods related to the orbital period of the satellite. These long period librations have amplitudes almost independent of the distribution of mass and bring no information on the geophysical interior. On contrary, the short period librations are sensitive to the interior as for example in Titan case where the presence of the putative ocean increases strongly the amplitude of short period librations or for Enceladus where the tidal deformations modify slightly the response of the body. Nevertheless, it will be necessary to take into account all librations (long and short) in order to interpret the future spacecraft observations of the satellites rotational motion for bodies such as Enceladus and the coorbitals Janus and Epimetheus because the amplitude of the long period librations dominate the spectrum.