



Resonant Rotation parameters of the Galilean satellites

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We provide updates to the resonant rotation parameters for the Galilean satellites. Under the assumption of a 1:1 spin-orbit resonance and zero obliquity we infer the resonant rotation parameters of the satellites from their ephemerides. First, we carry out a frequency mapping of the osculating orbital elements derived from the ephemerides. In particular we perform a frequency dissection through a Fourier transformation and a subsequent least-squares adjustment to the time series of the orbital elements. The resonant rotation parameters are then obtained from the fit results for the orbit inclination, the longitude of ascending node, and the true longitude. Considering ephemerides produced by the Institut de Mécanique Céleste et de Calcul des Éphémérides (IMCCE) and the Solar System Dynamics Group at the Jet Propulsion Laboratory (JPL) as well as through comparing the most recent estimates to previous ones, we obtain an uncertainty indicator for the resonant rotation parameters. This is in particular useful for interpretation of future measurements of the rotation of the satellites, e.g. a small deviation of the rotation axis from the Cassini state.

The rotational elements currently adopted for the Galilean satellites by the International Astronomical Union (IAU) Working Group for Cartographic Coordinates and Rotational Elements (WGCCRE) date back to the 1970s and do not reflect the improved knowledge in the orbits of the satellites obtained in the past decades. The comparison of our estimates with values documented in the IAU WGCCRE 2015 report reveals that the (zero obliquity) rotation pole, i.e. orbit pole, needs to be corrected by several hundred of meters for the four Galilean satellites. Likewise, the differences in the resonant rotation rates, i.e. the rotation rates of the satellites which exactly correspond to their orbital motion, accumulate to an offset of hundred to thousand meters over three decades.

The Galilean satellites are in focus of future spacecraft observations by ESA's Jupiter ICy moons Explorer (JUICE) and NASA's Europa Clipper. The availability of a reference frame and coordinate knowledge is critical for many remote-sensing applications intended by the instruments of the two spacecraft. Thus, in order to provide an operational framework for the observations by JUICE and Europa Clipper the reference rotational elements must be updated. Furthermore, the derived expressions can be used for comparison when actual measurements of the rotational states of the satellites become available.