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The nutations of a rigid Mars

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The nutations of Mars are about to be estimated with unprecedented accuracy (a few milliarcseconds) with the radioscience experiments RISE (Rotation and Interior Structure Experiment, Folkner et al. 2018) and LaRa (Lander Radioscience, Dehant et al. 2020) of the InSight and ExoMars 2020 missions, allowing to detect the contributions due to the liquid core and tidal deformations and to constrain the interior of Mars.

To properly identify the non-rigid contribution, an accurate precession and nutation model for a rigidly behaving Mars is needed. We develop such a model, based on the Torque approach, and include the forcings by the Sun, Phobos, Deimos, and the other planets of the Solar System, as well as geodetic precession and nutations. Both semi-analytical developments (for the Solar and planetary torques) and analytical solutions (for Phobos and Deimos torques and the geodetic precession and nutations) are considered.

We identify 43 nutation terms with an amplitude above the chosen truncation criterion of 0.025 milliarcseconds in prograde and/or retrograde nutations. Uncertainties related to modelling choices are negligible in comparison to the uncertainty coming from the observational uncertainty on the current determination of the precession rate of Mars (7608.3+/-pm2.1 mas/yr, Konopliv et al. 2016). Our model predicts a dynamical flattening H_D=(C-A)/C=0.00538017+/-0.00000148 and a normalized polar moment of inertia C/MR^2=0.36367+/-0.00010 for Mars.

References:
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