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Improvement of the Mars rotation parameters using the *a priori* information embedded in MOLA altimeter crossover data

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The Mars Global Surveyor (MGS) spacecraft is equipped with a laser-altimeter called MOLA (Mars Orbiter Laser Altimeter) which scanned Mars' surface during 3 years. The ground tracks of the laser-shots are crossing because of the rotation of Mars and the evolving orbit of MGS. Such crossing points contain additional information on the perturbation of the spacecraft orbit due to Mars' gravity field and its variations, Mars' varying rotation, and other phenomena. Therefore, using the differences in altimetry measurements (radial differences) at crossovers put some constraints on the MGS orbit and hence on Mars' gravity field and topography recovery (e.g. Neumann et al. 2001). With the objective to deduce Mars' rotation variations, we have used the tangential errors associated with each MOLA crossing ground tracks. In particular, we have investigated the possibility that these tangential crossovers can help us to detect the nutations of Mars and improve the determination of the length-of-day (LOD) variation. For that purpose, we have considered the inverse problem solved by a least-square fit based on the theory of Tarantola and Valette (1982), where the parameters are the rotation angles of Mars and the data are the crossover coordinates. Mars' rotation model used is the one computed by Konopliv et al. (2006). The *a posteriori* uncertainties of the rotation parameters are computed given the *a priori* information contained in the crossovers, i.e. the observed deviations of the crossover grids locations from theoretical predictions provided by the rotation model. The application on a fictitious crossover grid points demonstrates that, despite the low amplitude of the investigated signals, the huge number of crossovers makes the method accurate. It means that the use of the crossovers could possibly lead to the observation of the nutations of Mars and could give a better estimation of the LOD. A first application to

actual crossover points is also presented.

References:

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