Mars POD system and its application

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We present an independent software for Mars spacecraft precise orbit determination and gravity field recovery we call the Mars Gravity Recovery and Analysis Software (MAGREAS), which is aimed to investigate tracking data from the Chinese Mars exploration mission and similar NASA and ESA Mars-related projects. The design structure, module distribution, and functions of the software are described in this report. A detailed cross validation with the mature precise orbit determination platform Geodyn-II was done. Additionally, we use MAGREAS to process the MEX orbital tracking data with two-way and three-way tracking modes separately. Measurement residuals and the difference from the reconstructed ephemeris provided by Royal Observatory of Belgium indicate that our software is reliable. In this paper, we present a simulation of a four-way tracking mode between Earth tracking station, Mars orbiter, and Mars lander to validate the effectiveness of our MAGREAS-based approach for Mars orbiter determination and lander positioning. Experimental results show that our proposed tracking mode significantly improves positioning accuracy, as well as we simulate the contribution of this tracking mode in Martian gravity field recovery. This work will provide a reference for the design of the Chinese Mars exploration mission as well as for the processing of Chinese Mars mission orbital tracking data.

Keywords: Precise orbit determination, Martian gravity field recovery, MEX, Four-way Doppler tracking