Determination of Earth orientation parameters from Lunar Laser Ranging data

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Abstract

The Earth-Moon distance has been measured with Lunar Laser Ranging (LLR) since 1970. In the current analysis we use more than 31000 normal points (NPs) covering the period until June 2023. In recent years, there have been improvements in both, observations and analysis. For example, the NPs now are better distributed over the lunar orbit and retroreflectors. In addition, the measurements have achieved a higher accuracy and the number of NPs per night is higher compared to the years before 2015. Together with improvements in the LLR analysis software, such as refined modelling (e.g. of the lunar core) and changes in the analysis strategy (e.g. optimised calculation of ephemerides), the determination of various parameters in the Earth-Moon system is now possible with higher accuracy.
By analysing LLR data, Earth Orientation Parameters (EOP) such as the Earth rotation phase UT1, terrestrial pole coordinates, and nutation coefficients, as corrections to the MHB2000 model of the IERS Conventions 2010, can be determined along with other parameters of the Earth-Moon system in a least-squares adjustment. Focusing on UT1 and terrestrial pole coordinates, the accuracies of the estimated values from LLR data have improved significantly compared to previous results. We now achieve an accuracy of about 12 μs for UT1 and about 0.5 mas for xp and yp from an LLR time series with a minimum of 15 NPs per night and for the time span after the year 2000. Focusing on determining corrections to the nutation coefficients to the MHB2000 model, significantly smaller correction values and higher accuracies with an order of magnitude improvement, i.e., accuracies better than 0.01 mas, are obtained now. Recent results for these parameters are presented and discussed.
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