COMPARISON OF VLBI-BASED LUNI-SOLAR NUTATION TERMS

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1. Introduction

Very Long Baseline Interferometry (VLBI) is the only space geodesy technique that can directly observe the celestial pole offsets. These values are time-dependent corrections to the IAU2000A/2006 precession-nutation model that are estimated by different VLBI analysis centres. The celestial pole offsets, together with the rest of Earth Orientation Parameters (EOP) are combined by the IERS and disseminated in official series.

The purpose of this contribution is to compare the differences between the celestial pole offsets from different VLBI-based series consistent in terms of software configuration. Series provided by the International VLBI Service for Geodesy and Astronomy (IVS, Nothnagel et al., 2017) and combined solutions are analysed. The celestial pole offsets estimation series from each source are used as pseudo-observations for a least-square harmonic fitting to obtain different corrections to nutation.

II. Theoretical background

The Earth Orientation Parameters constitute the key input for the coordinate transformation between the Geocentric Celestial Reference System (GCRS) and International Terrestrial Reference System (ITRS). These parameters are the components of the polar motion ($\omega_x, \omega_y$), the difference UT1-UTC and the celestial pole offsets ($\alpha, \delta$) with respect to IAU 2000/2006 precession/nutation model.

From VLBI-based series of celestial pole offsets, it is possible to perform a least-square harmonic fit of the main nutation terms of the IAU2000A model:

$$dx = \sum_i a_{i}\cos\left(\text{ARG}\right) - \sum_j a_{j}\sin\left(\text{ARG}\right)$$

$$dy = \sum_i d_{i}\sin\left(\text{ARG}\right) + \sum_j c_{j}\cos\left(\text{ARG}\right)$$

where ARG are linear combinations of the fundamental arguments of the luni-solar nutation theory.

III. Software analysis

Table 1 presents a summary of the estimation strategies of the IVS analysis centers whose products are used in this work. This information is available at IVS ftp. Solutions not using ICRF2 as celestial frame have not been included in the analysis. Table 2 includes the list of the 42 nutation harmonic terms to be fitted. Columns $\Delta$ correspond to the multiplier factor of Delaunay arguments.

IV. Results

The corrections to IAU 2000A model were computed by means of a least-square harmonic fitting after having removing FCN by Belda et al. (2016) for the set of solutions aforementioned and also for combined solutions: IVS and EOP 14 CM (Bizouard et al., 2018). Time span is restricted to 1993-2016, since data before 1993 have poorer precision and temporal resolution (Belda et al., 2016). Estimated amplitude values and the differences with respect to the mean value are shown in Figure 1. Additionally, median amplitudes of the corrections to IAU 2000A model and the range between values are shown in Figure 2 and compared to the results reported by Gattano et al. (2017) and Yao (2013). It should be noted that in Gattano et al. (2017) all IVS solutions were used regardless their configuration, using data starting from 1984. In addition, they fitted their own FCN model. For Yao (2013), the fitted amplitudes correspond to an individual solution, so there is no figure for the range. Although the figures do not show a time-dependent magnitude in oscilla, lines are used for the sake of clarity.

V. Conclusions and future work

The results presented in this paper lead to the following conclusions:

- A comparison of the differences between the celestial pole offsets from different VLBI-based has been carried out and compared to the principal nutations of the IAU 2000A model have been computed. The results show in general a good agreement with similar studies on this topic.

- Disagreement with Gattano’s results for the longest rotation periods probably due to the different set-up of the analysis: different set and time span of IVS solutions and different model to remove FCN signal.

In the future, it is expected to add to this analysis GNSS-based estimation of celestial pole offsets (Puente et al., 2018). This would be a valuable contribution to the study of short-period nutation terms.

VI. References


Table 1. Estimation strategies of different IVS analysis centers.

Table 2. Harmonic terms and corresponding periods.

Figure 1. Amplitudes of the corrections to IAU 2000A adjusted to the nutation time series (top) and difference with respect to the mean value (bottom).

Figure 2. Comparison of the median and range of the amplitudes with respects to Gattano et al. (2017) and Yao (2013).