

Combination of Earth orientation parameters

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Two aspects of Earth Orientation Parameters (EOP) estimated by the space geodetic techniques VLBI, GPS and SLR will be addressed in this contribution. The first topic deals with the question whether UT1-UTC determined by VLBI is deteriorated when it is combined with the GPS or SLR derived time derivative LOD (the same holds for nutation and nutation rates). As a second aspect, the special case of estimating sub-daily polar motion will be discussed in view of the one-to-one correlation between nutation and a retrograde diurnal polar motion.

Each technique contributes in a different way to polar motion, universal time and nutation. These contributions are partly complementary or redundant. In particular, the satellite techniques can determine the time derivative parameters LOD and nutation rates, but they don't have access to UT1-UTC and nutation offsets in an absolute sense due to one-to-one correlations with the orbital elements. This capability has solely VLBI, however, VLBI is not able to determine the high frequencies in Earth orientation with very high precision. When integrating the satellite-derived rates to obtain time series of UT1-UTC or nutation, these series will suffer from considerable drifts and systematic effects. For these reasons, UT1-UTC, nutation angles and their time derivatives determined by VLBI and the satellite techniques complement each other and, therefore, it is worthwhile to combine them, preferably together with other common parameters (e.g. station positions). This will yield more stable and homogeneous equation systems and, as a consequence, the combined result is clearly better than any of the single-technique solutions. This is true in spite of the above mentioned drifts visible for GPS or SLR and it demonstrates that the capability of VLBI is not deteriorated in a combined solution. We will show this fact based on VLBI, GPS and SLR normal equations that were generated for the two-week time span of the CONT02 campaign. The normal equations were generated homogeneously using the same a priori models and the same parameterization for common parameters to come as close as possible to a rigorous combination even though it is done on the normal equation and not on the observation level.

The original temporal resolution of the pole coordinates and UT1-UTC in the normal equations mentioned above was set to one hour. Due to the estimation of sub-daily polar motion together with the two nutation angles a singularity between the retrograde diurnal polar motion term and an offset in nutation is present in the solutions, for VLBI as well as for the satellite techniques and consequently in the combined solution, too. To solve this singularity, we apply a constraint which blocks retrograde diurnal terms in polar motion. According to theory only a retrograde polar motion with an exactly diurnal period is correlated one-to-one with an offset in nutation. However, due to the limited temporal resolution of the Earth rotation parameters and the limited time interval considered, the situation is more complicated. We will show how the blocking mechanism works depending on these two limiting factors and what the consequences of this behavior are.