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.