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Associativity in the datum definition of VLBI analysis and its implication on the terrestrial reference frame

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Today, the separation of nutation and polar motion in Very Long Baseline Interferometry (VLBI) is per convention purely frequency-dependent. The physical meaning of the corrections to both phenomena (nutation and polar motion) is hitherto largely compromised. Nonetheless, VLBI remains the non-plus-ultra technique, as all other space geodetic techniques need to fix the a-priori nutation value to the one estimated by VLBI. In the past, the no-net-rotation condition (NNR1) imposed on corrections of quasar position was applied for retrieving corrections to the deficient a-priori precession/nutation model, while the no-net-rotation condition (NNR2) was applied to the corrections of a-priori station coordinates in order to obtain corrections to the a-priori polar motion and universal time parameters. The need and use of the no-net-translation on corrections of (a set of) a-priori station coordinates is unquestionable. An extensive analysis was performed, firstly to determine the number of minimal conditions or constraints necessary to get rid of the datum deficiency (for all parameter combinations), and secondly to determine the number of singular values from the normal matrix. In VLBI analysis, the NNR2 condition violates the null space w.r.t. the normal matrix for inner conditions. Its impact on the terrestrial reference frame is at the cm-level. Moreover, the common over-constraining, by using non-minimal weighted pseudo-observations of the datum parameters, is not recommended. The associativity of the NNR1 and NNR2 conditions was studied for its influence on the terrestrial reference frame.