

Numerical evidence for the inconsistent separation of the ITRF-ICRF transformation into precession-nutation, diurnal rotation and polar motion

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The differential equations relating the rotation vector of the earth to the elements of the matrix of rotation from terrestrial to celestial coordinates, provided daily by the IERS, are solved by two independent approaches: (a) a purely numerical approach based on the numerical differentiation of the elements of the rotation matrix and (b) an analytical approach based on equations which express the earth rotation vector in terms of the earth rotation parameters appearing in the rotation matrix and their time derivatives.

Both approaches gave identical results which demonstrate that the direction of the computed celestial pole, which is mathematically compatible and is based on observational evidence, deviates greatly from the Conventional Intermediate Pole (CIP). These deviations are dominated by two high amplitude frequencies, a semi-annual one and one with a period of 13.5 days. On the contrary the magnitude of the computed earth rotation vector yield length of the day variations which are in accordance with those provided by IERS.

The magnitude of the above deviations poses serious questions about the inherent lack of mathematical compatibility in the IERS earth rotation representation, which involves a direction of “diurnal rotation” (CIO) different from the one implied by the total rotation matrix. The IERS representation separates the total rotation into precession-nutation, diurnal rotation and polar motion parts in a mathematically inconsistent way, despite the improvements resulting from the introduction of the Non Rotating Origin (NRO) conditions, which guarantee a correct rotation rate but not also a correct direction of rotation.