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Improvement of the Earth rotation theory: recent advances and prospects

FERRANDIZ, Jose M.[1*] ; GETINO, Juan[2] ; ESCAPA, Alberto[1] ; BARKIN, Yuri V.[3] ; NAVARRO, Juan F.[1]

[1]University of Alicante, Spain, [2]University of Valladolid, Spain, [3]SAI, Moscow State University, Russia

Earth rotation is considered as one of the three pillars of modern Geodesy and is presently a very active field of research, due to the very stringent demands of accuracy resulting from a broad set of applications to various fields. The most stringent ones are those related with the monitoring of sea level, which is tightly linked to the climate change and related prevention policies, having both a big economic and social impact.

In 2013 the International Astronomical Union (IAU) and the International Association of Geodesy (IAG) approved the creation of an IAU/IAG Joint Working Group on Theory of Earth Rotation (JWG_ThER) chaired by the first author. This group has a singular structure since comprises 3 sub-working groups. Its purpose is promoting the development of theories of Earth rotation that are fully consistent and that agree with observations and provide predictions of the Earth orientation parameters (EOP) with the accuracy required to meet the needs of the near future as recommended by GGOS, the Global Geodetic Observing System of IAG. Such accuracy is of the order of 1 mm in position, measured on the Earth surface, which corresponds roughly to an angle of 30 micro arc seconds from the Earth's centre.

Those extreme requirements of accuracy challenge all of the theories that have been devised and used up to the date and demand their improvement, paying especial attention to the achievement of a level of consistency appropriate to the pursued accuracy not only in the internal construction of theories but in the realization of the celestial and terrestrial frames related to which the EOP are referred.

This presentation emphasizes the recent advances in the Hamiltonian approach to Earth rotation developed by the authors, since they provide a systematic and consistent way of treating a variety of Earth models and physical second order effects and derive accurate enough mathematical solutions, mainly by means of analytical perturbation methods.

Keywords: Earth orientation parameters, precession, nutation, second-order effects