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High-precision Earth Rotation Parameters Prediction with Physical Excitation Factors and Deep Learning Methods

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Abstract: The Earth is subject to complex internal and external forces in space. External forces include the gravitational attraction from the sun, moon, and other planets, and the internal forces include mass loads and frictional forces from the atmosphere, oceans, ice, snow, water, as well as interactions between the crust and mantle. Earth rotation parameters (ERPs) are essential for transforming between the celestial and terrestrial reference frames, and for high-precision space navigation and positioning. Amongst the ERPs, Polar Motion (PM) is a critical parameter for analyzing and understanding the dynamic interaction between the solid Earth, atmosphere, ocean, and other geophysical fluids. To investigate the impact of effective angular momentum (EAM) on long-term ERPs prediction, this thesis conducts research on long-term ERPs prediction considering EAM. Taking into account the influence of EAM, a discrete Liouville equation related to polar motion and UT1-UTC was first established, and the corresponding geodetic angular momentum was obtained. Finally, the residual geodetic angular momentum was obtained and modeled. Taking into account the residual of geodetic angular momentum and the experimental results of EAM, it is shown that, compared with Bulletin A, the LS+LSTM model has improved the accuracy of PMX, PMY, and UT1-UTC in the mid-and long term.

Keywords: Earth rotation parameters, Polar Motion, UT1-UTC, Least squares, Long Short-Term Memory model, effective angular momentum

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