MOTION OF THE EARTH'S POLE

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Using approximate methods of nonlinear mechanics, we construct a theoretical model of the polar motion that satisfies the astrometric data of the IERS. This model is shown to rationally explain the observed characteristics of a complicated oscillatory process executed by the angular-velocity vector with respect to a coordinate system associated with the Earth. In this report we substantiate the possibility of constructing a simple dynamic model using the methods of celestial mechanics. The realization proposed for the first-approximation model involves a small number of parameters determined from observations and makes it possible to reliably (from the statistic standpoint) interpret essential characteristics of the pole trajectory and give a reasonably accurate prediction from one to a few years.

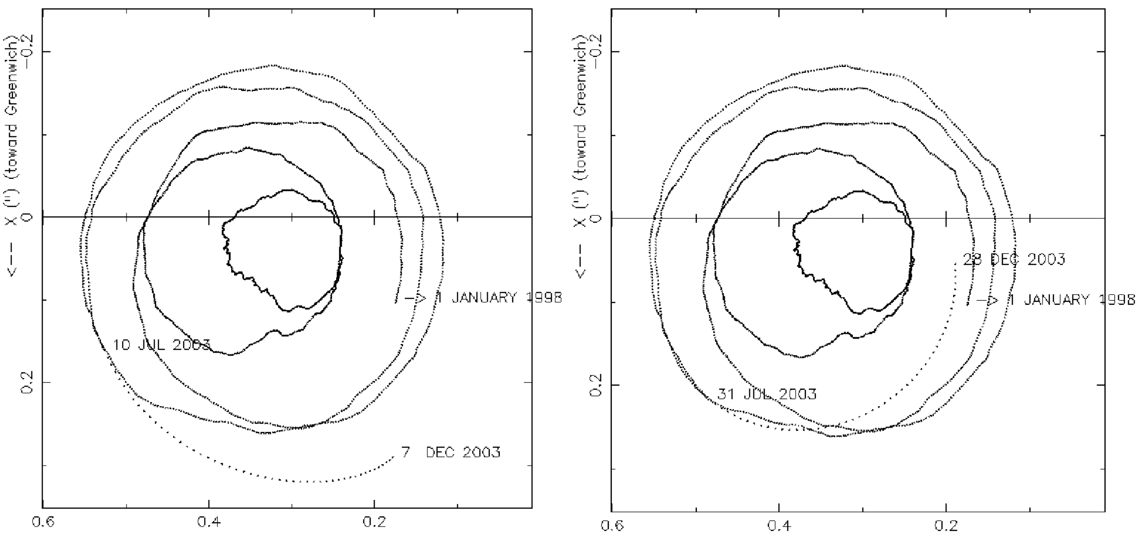

Figure 1: 100-dayes prediction (in dots) from the EOP Product Center.

The authors believe that the annual nutation oscillations can be explained and calculated on the basis of additionally taking into account the daily gravitational tides occurring in the deformable Earth. The simultaneous analysis of the Euler dynamic and kinematic equations for the inertia tensor deformed with the daily period in the coordinate system associated with me Earth, with allowance for the orbital motion and the figure-axis inclination to the ecliptic plane, makes it possible to establish the presence of the solar moment-of-force action with an annual period relative to the equatorial axes of inertia. The necessary value of the amplitude for this action attains $M_h = 10^{20}$ kg m^2 s^{-2} and leads to a relative variation of principal central

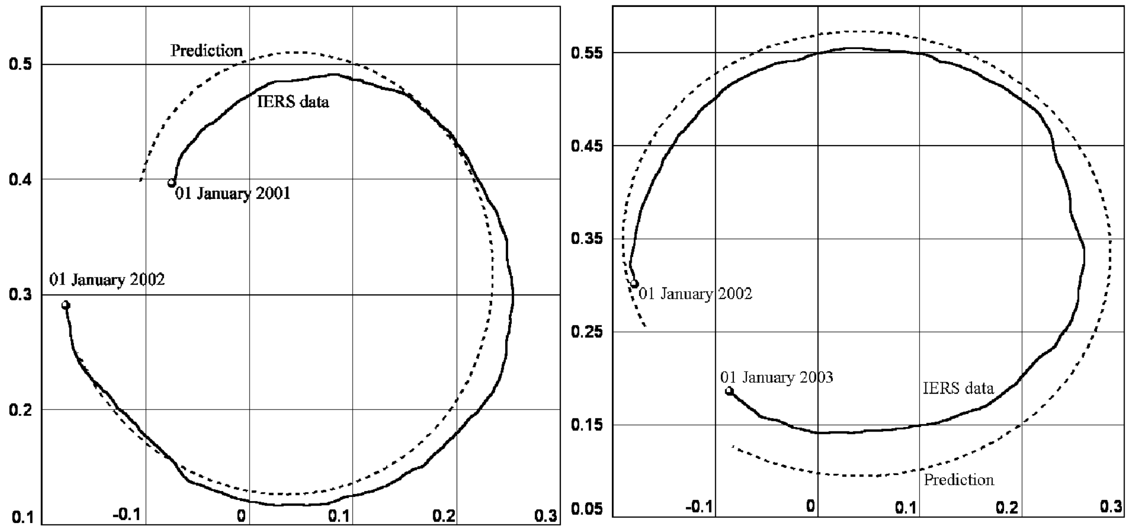

Figure 2: The prediction maded two-years (in dots) ago [1] and the real polar motion.

moments of inertia on the order of 10^{-5}. The effect of the lunar gravitational-force moment is less by a factor of 20, which is explained by a substantial difference in frequencies for eigenmodes and external actions.

We cearried out numerous calculations for verifying the efficiency ofthe model by the interpolation in time intervals from 2 to 20 years and the prediction of the trajectory for 1–5 years. The results obtained testify to the satisfactory accuracy for the interpretation of observations and for the prediction of the pole trajectory by a very simple theoretical first-approximation model. This model admits its natural refinement and complication by taking into account accessory factors to which we can also assign random perturbations.

Here on the figure 1 two variants with the 100-dayes prediction of the polar motion are depicted by dots. They were taken from the site of the EOP Product Center (http://hpiers.obspm.fr /eoppc/eop/eopc04/eopc04-xy.gif). As one can see the used algorithm of prediction is unstable and produce a rather big error.

The proposed by authors model in more details was published two years ago in (Akulenko et al., 2002) together with the prediction. On the figure 2 the comparison of two-years prediction by the above model and the real polar motion is depicted. The prediction was given at once (see for details (Akulenko et al., 2002)) and here for convenience divided into two parts. Each of them is equal to one year. As one can see this prediction is in the rather good agreement with the real data.

REFERENCES

Akulenko L. D., Kumakshev S. A., Markov Yu. G., 2002, Motion of the Earth's Pole, *Doklady Fiziki*, **47**, N 1, 78–84 (in Russian).