1. INTRODUCTION

The universally accepted model for the motion of the Earth’s instantaneous pole (IERS) describes the behavior of a dynamical system whose basis is formed by secular and two periodic components: the annual and Chandler ones.

In the case of a dynamical system, predicting or forecasting its evolution is a practical rather than theoretical problem, since this evolution is completely deterministic and the errors in determining the initial state can be removed on the basis of experimental data.

Nevertheless, the existing deviations of the theoretical model for the polar motion from high-accuracy observations in the past decades limit the possibilities for making a long-term prediction and cast doubt on the possibility of complete determinacy of the polar motion. The irregular pattern of the Earth’s rotation attributable to the influence of various external and internal factors, including the variations in tidal potential due to the action of celestial bodies, the changes in the angular momenta of winds and flows, glacier melting, the effect of the annual cycle of atmospheric excitation, the processes in the mantle and the core, etc., serve as the sources of this doubt.

Taking into account all of the significant external and internal factors that cause variations in the coordinates of the Earth’s pole on long time scales is a complex mathematical problem whose solution depends on the completeness of our knowledge of the nature of the perturbing processes and the methods for mathematical modeling of their influence on the Earth’s rotation. Since this problem has not yet been solved in general form, investigating the deviations of the pole’s coordinates from an ordered process and revealing the physical conditions for the appearance of these deviations are needed to refine the regime of the Earth’s polar motion on long time scales.

In this paper, we discuss the results of our study of the regime of the Earth’s polar motion using data on the instantaneous coordinates \(X\) and \(Y\) for the period 1962–2007.

2. ANALYSIS OF THE INITIAL DATA

The plots of the initial data on the motion of the Earth’s instantaneous pole \(X, Y\) (see Fig. 1) describe the superposition of a forced oscillation with a period of 1 year on the Earth’s Chandler oscillation.
Let us compare the process shown on the plots with conclusions of the theory for the case of undamped oscillations when the eigenfrequency and the perturbation frequency differ only slightly and the mathematical description is

\[
x = \frac{2x_0}{1 - \eta^2} \sin \frac{\eta - 1}{2} \sin \frac{\eta + 1}{2} \tau,
\]

where \(x_0\) is the initial amplitude, \(\eta\) is the frequency ratio, and \(\tau\) is a dimensionless time.

In this case, the amplitude of the enveloping oscillation varies as

\[
A(t) = \frac{2x_0}{1 - \eta^2} \sin \frac{\eta - 1}{2} \tau,
\]

while the time interval between the two minima of beat-type oscillations can be calculated from the formula

\[
\tau_s = \frac{2\pi}{\eta - 1}.
\]