THE STUDY OF THE STRUCTURE OF 142-YEAR SERIES OF POLE COORDINATES

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ABSTRACT. The 142-year series of pole coordinates in the system of mean pole of epoch of observation are used for the investigation of the Chandler period. The method of the best approximation of the initial data with the step of 1.5 years by means of quasi-polynomials is used.

1. Guidelines

Searching for the correlation between polar motion and different types of geophysical phenomena, we must take into account the presence of systematical errors and homogeneity of the data lists which are used. From this point of view, the 142-year series of pole coordinates in the system of the mean pole of epoch of observation, which was published by the Main Astronomical Observatory of the Ukrainian Academy of Sciences [1], is very suitable for the study of the Chandler period of polar motion, since it is very homogeneous and it does not have long-period components.

In [2] we have proposed a numerical method of the prediction of polar motion and UT1–UTC values using a quasi-polynomial set. The number of variable parameters and their values was found as a result of the best approximation to the initial data series. The predictions were made using published Rapid Service IERS data. A comparison with USNO predictions showed good qualities of the quasi-polynomial model for approximation and prediction.

We used the method for searching for the Chandler period in that 142-year series.

2. Mathematical model

The quasi-polynomial model is a set of polynomials, exponential, and trigonometric functions:

$$Z = \sum_{i=1}^{n} A\, t^{\eta} e^{\xi t} \left(\cos \frac{2\pi}{P_i} t + \sin \frac{2\pi}{P_i} t \right)$$

where A, ξ, η and P_i are variable parameters which are determined during the solution of the problem of obtaining the best approximation to the coordinates x,y on a moving 1.5-year interval.

J. H. Lieske and V. K. Abalakin (eds.), Inertial Coordinate System on the Sky, 157–159.

Existing uncertainties in the periodic components, in quasi-periodic and aperiodic components are taken into account during the choice of the exponential functions' variable parameters.

3. Results

For the investigation of the pole coordinate series *x, y* N = 81 sets of quasi-polynomial parameters were obtained. In each of these sets of parameters, annual and Chandler components were also obtained. The annual period has inessential changes near the mean value of 365.24 days. The estimations of the Chandler period can be seen in Fig. 1.

The correlation and inter-correlation functions $Cp_xp_y(\tau)$, $Cp_yp_y(\tau)$ and $Cp_xp_x(\tau)$ are shown in Fig. 2. From that we can conclude that the p_x and p_y sets do not contain well-determined components other than non-zero means. The values of these means are

$$\bar{P}_x = 419.4 \text{ d} \pm 18.6 \text{ d} \quad \text{and} \quad \bar{P}_y = 419.6 \text{ d} \pm 18.7 \text{ d}.$$

In Table 1 the statistical characteristics of the deviations ΔP_x and deviations ΔP_y are given,

Table 1.

	A	E	χ^2_E	$\chi^2_T (L = 99\%)$
ΔP_x	+0.3 ±0.46	−0.48±0.63	9.18	11.30
ΔP_y	−0.2±0.46	−0.62±0.46	9.27	11.30

where A is the asymmetry; E is the excess; χ^2_E is the experimental value of the χ^2 criterion; and χ^2_T is the theoretical value of the χ^2 criterion for significance level $L = 99\%$. There are not any serious deviations of the ΔP_x, ΔP_y deviations of the experimental distribution from the theoretical one.

4. Conclusions

Using the 142-year series of coordinates, a statistically steady estimation of the Chandler period is 419.4 d ± 18.6 was obtained. The period was confirmed and specified via the independent method of spectral analysis of zero intersections. The analysis of the Chandler period has not given any basis for speaking of two or more close frequencies.

References

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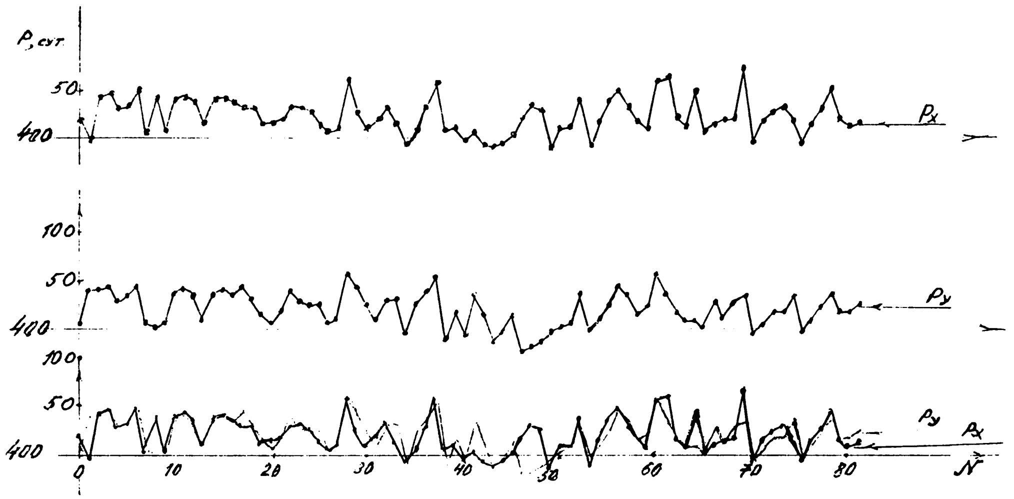

Figure 1. Estimates of the Chandler Period in the interval 1846–1987.

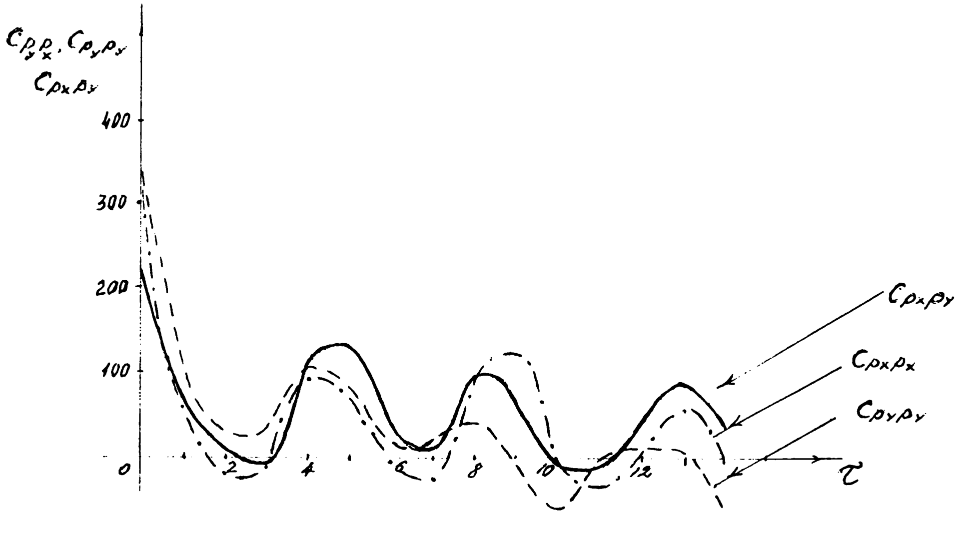

Figure 2. Correlation functions Cp_{xy}, Cp_{yy} and the mutual correlation function Cp_xp_y.

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