VELOCITY OF THE MOTION OF THE TERRESTRIAL POLE

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ABSTRACT

The results of the spectral analysis of the velocity of the polar motion based on the data of the International Latitude Service (ILS), International Polar Motion Service (IPMS), Bureau International de l'Heure (BIH), and the Doppler Polar Motion Service (DPMS) are presented.

1. INTRODUCTION

Since the polar coordinates are computed for equally spaced time intervals, n-1, n, n+1, etc., the velocity may be represented by the distance, S_n, the pole moves during these intervals. Thus the minimum velocity during the time interval, n, denoted by V_n can be given by

$$V_n = S_n = [(x_n - x_{n-1})^2 + (y_n - y_{n-1})^2]^{\frac{1}{2}}.$$

2. OBSERVED VELOCITY

Four different sets of polar coordinates were analyzed:

a. BIH five-day values from 1967 through 1976 (Annual Report of the BIH),
b. ILS, IPMS, BIH values for every twentieth of a year from 1962 through 1967 (Annual Report of the BIH, Annual Report of the IPMS),
c. DPMS five-day values from 1972 through 1976 (U. S. Naval Observatory Time Service Pub. Series 7),
d. ILS and BIH values for every tenth of a year from 1900 through 1976 (Annuaire 1974 du Bureau des Longitudes, Annual Report of BIH).

The velocities computed for the five-day intervals are very noisy. The velocities derived from the other data (Figures 1 and 2) show that there are no Chandler and annual periodic variations in the velocity but

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there is a variation with a period of six or seven years. The variation in velocity is quite similar for the ILS, IPMS, and BIH data.

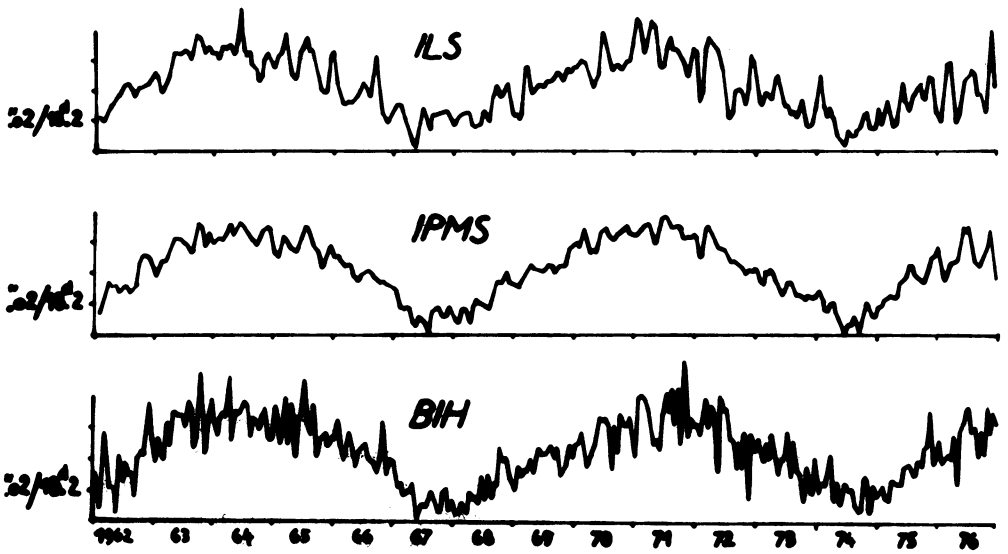

Figure 1. Rate of polar motion in twentieth of a year intervals 1962-1976.

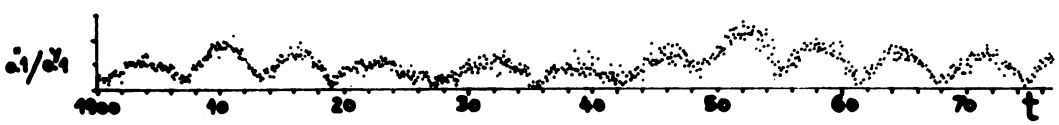

Figure 2. Rate of polar motion in tenth of a year intervals 1900-1976.

3. SPECTRAL ANALYSIS

The solid-line spectra in Figures 3 and 4 show the results of the spectral analyses of the V_n data. To avoid the influence of the low-frequency terms in the spectra it was decided to perform a similar analysis on the first differences of the V_n data, $\Delta V_n = V_n - V_{n-1}$. Physically these data are proportional to the accelerations of the polar motion. Periodic variations in V_n should also be present in the ΔV_n data, but the low frequencies will be damped.

The results of the spectral analyses of the ΔV_n are represented in Figures 3 and 4 by broken lines. The similarity in the periodicities found in the spectra of the V_n and ΔV_n is apparent. The enhancement of the higher frequencies in the spectra of the ΔV_n data is also noticeable.

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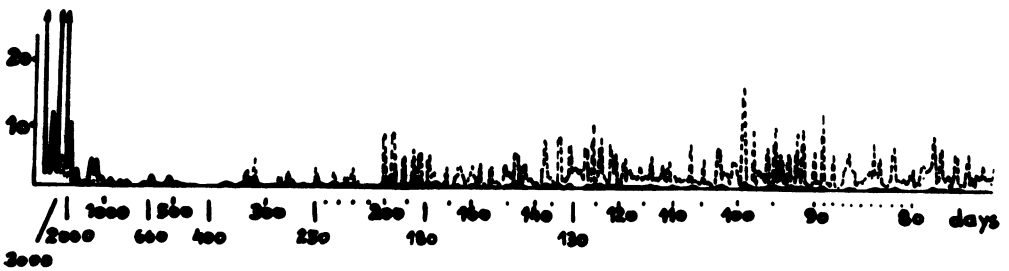

Figure 3. Spectral analysis:
a. (solid line) rate of polar motion in tenth of a year intervals 1900-1976;
b. (broken line) first differences of the rate of polar motion in tenth of a year intervals 1900-1976.

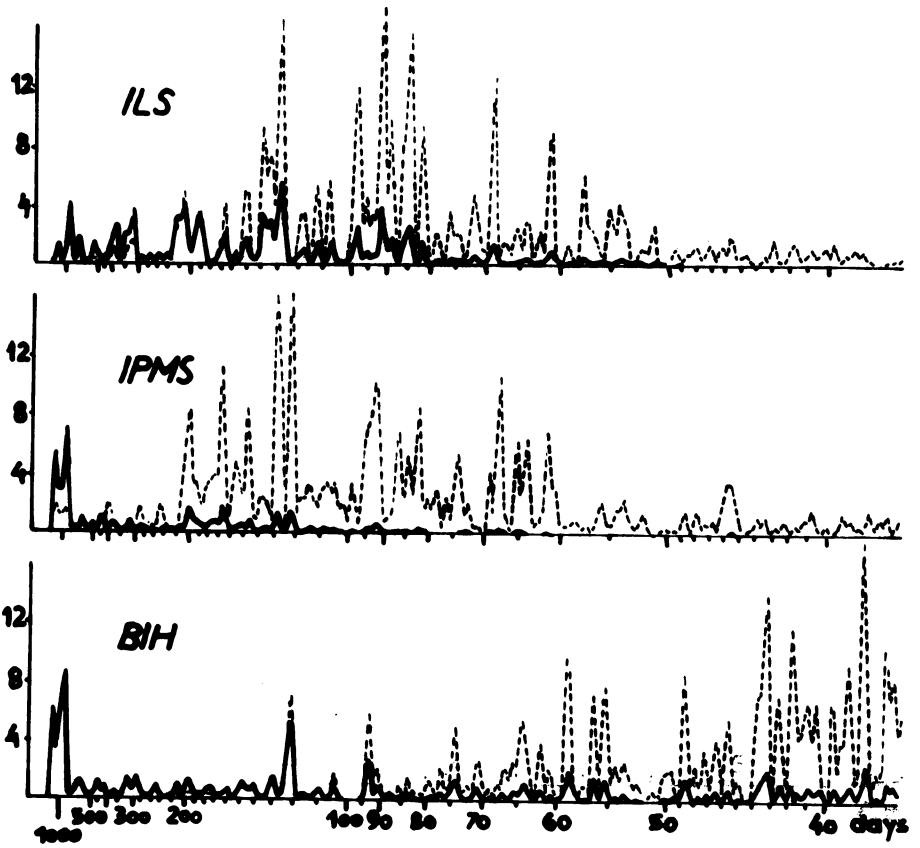

Figure 4. Spectral analysis:
a. (solid line) rate of polar motion in twentieth of a year intervals 1962-1976;
b. (broken line) first differences of the rate of polar motion in twentieth of a year intervals 1962-1976.

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4. CONCLUSIONS

This spectral analysis of the velocity and acceleration of the polar motion allows us to draw the following conclusions.

1. The main components of the polar motion (Chandler, annual, and semi-annual) have constant velocities.

2. Distinct variations of the velocity with periods of 6.0 and 6.8 years are present. These may be due to superpositions of annual and Chandler periods as well as semi-monthly and semi-annual nutation components.

3. High-frequency components with periods of 320, 190, 220, 120, 90, 27, 18, 14, and 11 days are less distinct. These may be explained by the superposition of nutation components (Table 1).

4. Strong disturbances of the Earth's rotation occurred from 1918 to 1930. Separate spectral analyses of V_n for the periods 1900-1919, 1917-1936, and 1932-1977 show that during the period 1917-1936 the six-year components disappeared and a ten-year periodicity was present.

5. It is advantageous to analyze the velocity of the polar motion because of its independence from the reference system.

Table 1. Periods of superimposed nutation components.

Period (days)	Contributing Nutation Term Periods (days)
1030	182.62, 5.64
327	13.66, 26.94
202	13.66, 14.76
186	13.66, 13.63
131	13.66, 9.56
125	13.66, 9.13
97	13.66, 7.10
94	13.66, 6.86
77	13.66, 5.64

REFERENCES

Annuaire 1974 du Bureau des Longitudes: Paris.
Annual Report of the Bureau International de l'Heure for the years 1967-1976: Paris.
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DISCUSSION

D. Djurovic: Have you identified a term which has a period close to 122 days in the latitude spectrum?
B. Kolaczek: Yes.

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