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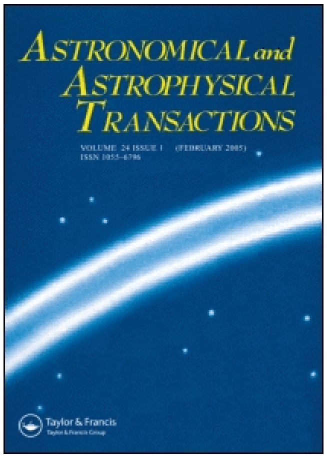

Astronomical & Astrophysical Transactions
The Journal of the Eurasian Astronomical Society
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713453505

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Online Publication Date: 01 November 1995
To cite this Article: Gorshkov, V. L. (1995) 'A statistical analysis of the pulkovo time service database', Astronomical & Astrophysical Transactions, 8:4, 307 - 309
To link to this article: DOI: 10.1080/10556799508226947
URL: http://dx.doi.org/10.1080/10556799508226947

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Astronomical and Astrophysical Transactions, 1995,
Vol. 8, pp. 307–309
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A STATISTICAL ANALYSIS OF THE PULKOVO TIME SERVICE DATABASE

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(Received May 18, 1993)

The statistical analysis of many years observations by photoelectric transit instruments of the former USSR astronomical time services was made. The law of the errors distribution for these observations was evaluated. It was shown that observations of each instruments correspond to normal distribution much better than united ones. It can be explained by systematic errors in the photoelectric observations. Some of these errors are discussed.

KEY WORDS **Earth rotation, data analysis**

The Pulkovo time determination database (DB) (Gorshkov *et al.*, 1989) includes now about 300 000 observations of nearly 1000 stars made by 8 photoelectric transit instruments (PTI) of the former USSR during the last twenty years. This DB has two levels of the data:

a) The initial observational data (star number, transit time of the observed star, inclination of the PTI axis and various meteorological and PTI current data).

b) The data processed in the KSV (Gorshkov *et al.*, 1989) reference system (for each star (i) on the date (j), the clock correction $u_{ij} = \mathrm{UTO}_{ij} - \mathrm{UTC}$ and all the information on the observations made on this date are given). Some of these data are stored at the central DB of the IAU WG on Earth Rotation in the HIPPARCOS Reference Frame (Vondrak and Ron, 1992).

A large amount of observations of each star enabled us to verify the hypothesis of a normal distribution of these observational data and thus to support the wide application of a least-squares method for the reduction of these data (Vondrak and Ron, 1992). This hypothesis was verified for the stars observed less than ninety times by means of asymmetry (A) and excess (E) of the error distribution and for the others by means of the $\chi^2_{0.05}$ distribution.

The following quantities were analyzed for each PTI and for the united set of observations: $w_{ij} = v_i - v_{ij}$, where $v_{ij} = u_j - u_{ij}$, $v_i = \sum_j v_{ij}/n_i$, $u_j = \sum_i u_{ij}/n_j$,

Table 1. Statistical data of the PTI observations

PTI	*LAT*	*S(ms)*	*R*	*A*	*E*	*%NORM*	*%PIRS*
PUH (72–91)	60	10.1	0.7	0.04	0.41	68.2	8.9
PUG (71–85)	60	10.4	0.7	0.01	0.37	75.2	6.5
RG (75–85)	57	11.0	1.0	−0.04	0.37	81.8	9.1
IRF (79–91)	52	10.9	1.1	0.0	0.18	87.4	4.2
KHF (80–88)	50	11.4	0.8	−0.03	0.03	85.5	4.8
NK (77–85)	47	9.9	1.1	0.0	0.11	100.0	0.0
$\sum$		10.8	0.8	−0.01	0.47	43.2	47.7

Table 2. Seasonal errors of the PTI observations m_j (msec)

	PUH	*PUG*	*RG*	*IRF*	*KNF*	*NK*
winter	21.0	21.2	23.3	21.1	18.6	18.4
spring	20.5	21.1	22.7	21.2	20.0	19.5
summer	22.0	21.7	21.0	21.1	20.9	20.3
autumn	19.4	20.4	20.1	20.7	18.9	18.5

n_i is the number of all dates when the i'th star was observed and n_j is the number of stars observed on the j date.

Table 1 presents information for the PTIs which have been sufficiently engaged in observations. Observing errors for each PTI are given as follows: $S = S_i \cos\delta(\cos z)^R$, where $S_i^2 = [w_{ij}\, w_{ij}]/(n_i - 1)$.

Our statistical conclusions on these data are as follows:

1. Observations of each PTI correspond to a normal distribution much better than the united set $\sum$. Hence, it is necessary to introduce some systematic corrections in any reduction model for processing these data.

2. The stars observed in May-October ($18 < \alpha < 22$h) form the greatest part of non-normally distributed errors of the observations and the number of such stars increases at high latitudes. This can be due to the influence of white nights on the photoelectric observations. However, an ordinary analysis of the errors $m_j = [v_{ij}\, v_{ij}]/(n_j - 1)$ has not shown any seasonal differences in it as it may be seen in Table 2, i. e. these sets are statistical homogeneous ones.

3. For the stars with a non-Gaussian distribution of errors, the distribution parameters (v_i and s_i) were evaluated by means of the Pirson VII-curve (Idelson, 1947) ("PIRS" in Table 1) and the excess as an input parameter. The remaining stars (up to 100%) did not correspond to any of these distributions. It may be more preferable to use a more robust L_p-estimation for all these observations.

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