IMPROVED PROPER MOTIONS IN DECLINATION OF HIPPARCOS STARS DERIVED FROM OBSERVATIONS OF LATITUDE

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ABSTRACT. At the end of 20th century, the HIPPARCOS Catalogue was finished, and near 4.4 million astrometric optical observations (made at 33 observatories) of near 4.5 thousand HIPPARCOS stars used for the investigations of latitude/universal time UT0 variations were collected. Nowadays, these optical observations are useful for improvement of proper motions of HIPPARCOS data; the long history optical observations (during the interval 1899.7-1992.0) can improve them (at the first place, the long term part). Here, some results of improved proper motions in declination (of some HIPPARCOS stars) are presented; we used the optical observations of latitude variations made with Photographic Zenith Tubes (PZT).

1. INTRODUCTION AND RESULTS

The ICRF started to materialize the ICRS from the beginning of 1998, after decision of the GA of the IAU in Kyoto 1997. The precision of 608 compact radio sources (Ma et al. 1998) is of 0.3 to 0.5 mas (milliarcsecond), and some time ago it was added 59 new sources by the ICRF – Ext.1 (IERS Annual report 1999). The HIPPARCOS Catalogue was started to be the optical counterpart of the ICRF in 1997. The ESA mission (ESA 1997) produced two catalogues: Hipparcos one and Tycho one. Hipparcos Catalogue, as an optical frame, contains 118218 stars, brighter than magnitude 12, with very large number of parameters (precise parallaxes, positions, proper motions, photometry, etc.). The accuracy of the positions is at the order of 1 mas at the epoch of the catalogue 1991.25. The standard error of the proper motions in $\mu_\alpha \cos(\delta)$ and μ_δ is about 1 mas/year. But the mission lasted too short time (less than four years) for the mentioned proper motions accuracy of some stars, mostly double and multiple ones. Nowadays, there are several programmes, based on the long history ground – based data, to remove that problem, and to achieve a better reference frame (more stable in time). Some new catalogues appeared, as the combinations of the ESA mission data with the ground – based ones: FK6(I), FK6(III), ACT, TYCHO – 2, GC+HIP, TYC2+HIP, ARIHIP; the most recent one is the Earth Orientation Catalogue – EOC (Vondrák and Ron 2003). Here, we used few PZTs latitude data (Vondrák et al. 1998) to improve the proper motions in μ_δ of some Hipparcos stars. These

PZTs data (Vondrák and Ron 2002) are: Punta Indio-PIP (Argentina,1971.6-1984.5), Mount Stromlo-MS (Australia,1957.8-1985.7), and Ondřejov-OJP (Czech Republic,1973.1-1992.0).

We made the separate file for each Hipparcos star (with all observations of that star observed at PIP, MS or OJP). There were: 165 Hipparcos stars observed at PIP, 184 stars at MS, 285 stars at OJP, 157 common PIP and MS stars. Because a lot of common PIP/MS stars, the PIP and MS data are very interesting for checking our procedure of calculation. The curve of the component of double/multiple star ($\Delta\delta$ or $\Delta\alpha\cos\delta$ with time) can be very complicated; in this paper we present the results made with the linear model. The polar motion effect $\Delta\varphi_i$ (calculated one) was removed from the data of each star by using x and y coordinates of polar motion from the file EOPOA00.dat (Vondrák 2000) and Kostinski formula (Kulikov 1962). Then, we continued with the residuals r_i (for the moment i) for each star ($r_i = \Delta\varphi_i - \varphi_n$). The value φ_n is the mean value of n observations of latitude (of some Hipparcos star observed during subperiod near one year long). In line with 2.7*σ statistical criterion, we removed some residuals (of some subperiods). For each star, we have got near one point (residual r_i) per year. Each point is with: MJD (the moment i), residual r_i, standard error of r_i, and number of latitudes n.

To determine the free term a, linear one b, and its standard errors, we used the Least – Squares Method (LSM) and the linear model $Y(j) = a + b * (X(j) - 1991.25)$, where: $X(j)$ is the time (MJD transformed into years), $Y(j)$ – mentioned residuals, j is the number of residuals (points). For any mentioned star, our value of b have the correct sign to be added to the proper motion in declination as given in the Hipparcos Catalogue. We calculated the values of a and b of each instrument and removed these values from the values of a and b of each star observed with that instrument. The calculated trend of each instrument was found from the residuals of lot of stars observed by that instrument. Finally, we have got the results (LSM, linear model, no weights); only a few examples are given here:

- PIP, H45995 , $a = +0.''037 \pm 0.''045$, $b = +0.''0023/year \pm 0.''0033/year$,
- MS, H45995 , $a = +0.''069 \pm 0.''025$, $b = +0.''0038/year \pm 0.''0012/year$,
- PIP, H53399 , $a = +0.''048 \pm 0.''044$, $b = +0.''0027/year \pm 0.''0032/year$,
- MS, H53399 , $a = +0.''070 \pm 0.''019$, $b = +0.''0032/year \pm 0.''0009/year$,
- OJP, H83885 , $a = -0.''050 \pm 0.''031$, $b = -0.''0063/year \pm 0.''0030/year$,
- OJP, H90454 , $a = +0.''029 \pm 0.''018$, $b = +0.''0062/year \pm 0.''0018/year$.

The presented results of the stars H45995 and H53399, from PIP and MS data, are in good agreement between each other, and it means that our procedure is relevant for that kind of investigations. It is necessary to be careful with PZT latitude data because of its level of formal errors (much bigger than the Hipparcos ones), and different kinds of systematic ones. These long series of historical data still can give us useful results. It is possible to improve the proper motions in declination of some Hipparcos stars by using the latitude data of PZTs.

2. REFERENCES

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