A PROGRAM FOR A NEW REDUCTION OF PLATES OF THE ASTROGRAPHIC CATALOGUE

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The Astrographic Catalogue is the major source of accurate first epoch coordinates of stars down to about 11 mag all over the sky. Therefore it could be the ideal tool for the determination of proper motions in this range of magnitudes - see also for example Fresneau (1985). There were mainly three reasons which prevented in the past a frequent use of this catalogue:

1) Apart from the „french" zones (Lacroute 1981) the AC is not available in machine readable form.
2) Only measured plate coordinates x,y and plate constants mostly derived with the AGK1 as reference catalogue have been published.
3) The lack of easy to use software for a new reduction.

In many problems one is not interested in the whole sky, but in certain small regions of about a dozen square degrees. Problem 1) may thus be overcome by just converting the data from a few plates of interest into machine readable form. We report in this paper on the methods applied and the program developed at the ARI to handle problems 2 and 3.

THE PROGRAM

The program package we developed at ARI contains three (four) major steps:

a) reduction of the plates using the old (printed) plate constants
b) identification of reference stars from the ARI Catalogue of Astrometric Data (Bastian and Lederle 1985)
c) new reduction of the plates using the reference stars identified in b)
d) An identification of the AC-stars on the appropriate plates with a preliminary version of the CPC2 (de Vegt 1985) is performed to derive proper motions (only on the southern part of the sky).

The user has to enter the program with the information about the plate taken from the published volumes of the Astrographic

S. Débarbat et al. (eds.), Mapping the Sky, 441–444.

Catalogue. These data are:
Plate center, six plate constants, epoch of the plate, and information about the conversion of measured diameters to magnitudes (optional) and last but not least the measured x,y coordinates of the stars on the plate. With this information the program will automatically perform steps a) through d) and supply to the user the newly reduced plate. However, as we shall explain below, the user can interrupt the program for specific control.

Step a) is trivial and needs not be explained any further. The program automatically selects the correct formula to calculate standard coordinates from plate constants and x,y coordinates. This step requires very little computer time and as a result, one obtains equatorial coordinates (1950.0) on the system of the old reference catalogues which were in most cases the zones of the AGK1. The old plate constants are sufficient for identification of the reference stars in step b). It is therefore not necessary to use the newly derived plate constants, for example Eichhorn and Gatewood (1967), Günther and Kox (1970), Herget (1973).

Note, this step alone will give no information about the quality of the resulting positions. Errors in the old plate constants, originating either from blunders of the old authors or just misprints, can be detected only if they lead to obviously very bad results. Errors which yield coordinates just a few seconds of arc off can and will only be detected in the following steps.

Step b) identifies those stars on the plate which are in the ARI catalogue. This catalogue is available at our institute in a kind of blocked direct access mode, the access to any position in the sky is thus rather quick. As standard identification window we use a square of 10*10 sec of arc. This is always sufficient, since we take proper motions into account. A failure in this identification step reveals errors in the plate constants or the format of the x,y coordinates. Misidentifications or double identifications will be detected and removed in the next step.

Although step c) is integrated in the program string, the program can be interrupted here and this step can be performed separately in an interactive mode. A second order polynomial fit is made between the calculated and the measured x,y. In the integrated mode a reference star is automatically skipped if its distance from the fit is more than 20 microns corresponding to 1".2 on the standard astrograph plates. It is a drawback of this integrated mode that the program may skip so many stars that only a few more than the minimum number for the fit are retained. To avoid this, one can select the interactive mode, in which one gets all the information needed for the analysis of errors. One can then examine the input data, correct them and restart the program.

The last step can be carried out only for objects in the southern sky, because the stars on the plate are identified in the preliminary

CPC2 (de Vegt 1985). Its purpose is the derivation of proper motions for those stars which are contained in the CPC2. Due to the large epoch differences, these proper motions are more precise than those in the SAO Catalogue.

Although most of the efforts in this program package are concentrated on the astrometric part, we have also dealt with the photometric data given in the catalogue. Being well aware of the problems to use simple formulas for e.g., conversion of diameters into magnitudes (Weaver 1946), we mainly selected formulas as given in the introductions to the various zones of the AC. However, we would guess that the precision on a plate is better than 1 mag, which should suffice for identification purposes.

At present we have processed 208 occasionally selected plates mainly in the southern sky containing about 75000 stars.

APPLICATIONS

We just mention here some applications of the program without any claim of completeness:

1) to find accurate coordinates of interesting stars. Gliese (1986) reports for example, that in the 2nd Catalogue of Nearby Stars, the positions of 16% of the stars are available from the AC only.

2) Röser (1987) was able to identify the fainter reference stars for the observations of comet Halley between 1909 and 1911 in the AC. It was extremely fortunate that the epochs of the AC-plates were so close to 1910, so that the errors introduced through neglecting proper motions were small compared to the measurement error of the angle between comet and reference stars.

3) Blunders can be detected in AGK2/AGK3, such as spuriously high proper motions in AGK3, or interchanged positions of double stars.

4) AC positions provide a valuable source of identification for stars of astrophysical interest which were proposed for the HIPPARCOS Input Catalogue. Otherwise only poor positions for those stars are available from the source catalogues.

REFERENCES

Bastian,U. and Lederle,T. (1985): The ARI catalogue of astrometric data for the HIPPARCOS Input Catalogue. In: ESA SP-234, Compiled by T.D.Guyenne and J.Hunt. Noordwijk, p.185

Eichhorn,H., and Gatewood,G.D. (1967): Astron.J. 72, p.1191

Fresneau,A. (1985): Astron.J. 90, p.892

https://doi.org/10.1017/S0074180900139981 Published online by Cambridge University Press

Gliese,W. (1986): in IAU Symp.No.109 Astrometric Techniques
eds. H.K.Eichhorn and R.J.Leacock p.653
Günther,A., Kox,H. (1970): Astron.Astrophys.4, p.156
Herget,P. (1973): Publ.Cincinnati Obs.No.24
Lacroute,P. (1981): Bull.Inf.CDS Vol. 21, p.2
Röser,S. (1987): Catalogue of astrometric observations of comet
P/Halley at its apparition 1909-1911. Astron. and Astrophys.
Suppl.Ser. (in press)
de Vegt,Ch. (1985): private communication
Weaver,H.F. (1946): Popular Astronomy Vol.54, p.464

https://doi.org/10.1017/S0074180900139981 Published online by Cambridge University Press