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Remote Access to the Tycho Catalogue and the Tycho Photometric Annex

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Abstract. The TYcho Catalogue (TYC) will contain astrometric and mean (de-censored) photometric data of some 1,058,000 objects. The TYC will be published in June 1997 together with all other Hipparcos mission products.[1] The number of observations per object used to produce the TYC is 130 in the mean over the whole sky in the two bands B_T and V_T, making the TYC/TEPA one of the largest photometric databases in the world. For a total of about 500,000 objects, the brightest and some selected fainter objects, the single observations will be published in the so called Tycho Epoch Photometry Annex B (TEPA/B). This Annex will be available through the CDS in Strasbourg, France. A subset thereof, the TEPA/A, containing the observations of about 36,000 selected objects will be published on a CD-ROM. The measurements of the fainter 500,000 TYC stars are not considered to be of a quality to be published, because the errors and the censoring of the individual observations of the faint stars are too large. This paper presents an access and research tool for the TYC and the TEPA to be used locally with widget based GUIs or remotely by HTML-form based WWW-pages.

1. Motivation

Especially the TEPA/B data base needs an easy to use, powerful access tool providing data for selected objects. The Tycho Data Analysis Consortium (TDAC) is using an access tool, where the core is a collection of IDL routines controlled by an IDL-widget based GUI. The size of the TEPA/C (all observations for all TYC objects) sums up to about 50 GB binary data and it thus resides on a single host within TDAC. To provide access for all the TDAC groups there is a WWW-layer above the IDL access tool which copies some of the functionalities to a small number of HTML-form pages. The interface is currently being updated with client side image maps, JavaScript verification and Java tools to limit the network traffic and the server load. If support by the host institute is approved this interface will be opened to the WWW[2] without restrictions at

[1] A complete description of the Hipparcos and Tycho Mission and data reduction may be found in (Perryman 1989), some more detailed papers on Tycho and Hipparcos in two series of papers from various authors in (A&A258, 1992 and A&A304, 1995)

[2] http://astro.uni-tuebingen.de/

the time when the Hipparcos and Tycho catalogues are published, i.e., in June 1997.

Since the Tycho instrument on-board the Hipparcos satellite was operated at a fixed sampling rate (integration time), observations for faint stars are censored, i.e., the magnitude distribution of the observations has a clear cut-off caused by the used SNR limit. For the de-censoring and variability studies the number, time, and background of all unsuccessful observations for a given star contains very important information. The two Annexes, TEPA/A and TEPA/B will contain all successful and unsuccessful observations for about 36,442 selected stars (TEPA/A) and the 481,553 brightest stars (TEPA/B) of the TYC. The mean number of observation per star in these catalogues is 191, giving a total of more than 6 million and 90 million observations for TEPA/A and TEPA/B respectively. Access to this photometric data base should be easy to use, yet powerful and flexible.

2. Data Structure

The TYC is a quite normal star catalogue very similar to the GSC in numbering and sorting. Stars common to TYC and GSC version 1.2 do have the same primary (region) and secondary (running) numbers in both catalogues. Yet the TYC contains a third identification number in order to keep double stars resolved by Tycho under the same GSC region and running numbers. The identification numbers in TYC are called TYC1, TYC2 and TYC3, where TYC3 is just 1 for most of the stars. Because of the similar numbering and sorting scheme any catalogue browser capable of browsing through GSC should be able to access the TYC without major changes. On the other hand the TEPA catalogues are much different and they need a special tool to provide access and working capabilities such as time series analysis (variables) or selection of single observations. The TEPA/A will be published on a CD-ROM together with basic access software, i.e., it will be possible to retrieve all observations for one of the TYC-stars contained on the CD-ROM. This software might also be used to retrieve data from the TEPA/B which will only be published through astronomical data centres (CDS, Strasbourg).

The TEPA catalogues contain two different kinds of records: star header records and observation records. Each star header record is followed by a number of observation records. The star header records contain some fundamental data extracted from the TYC, such as the star numbers, and the magnitudes, but no coordinates. The contents of the star headers is merely a compromise between necessary and useful contents and the need to keep the record length at the same length as the observation records are. The most important field of a star header is the number of observation records following the star header. The length of the observation records is adjusted to contain all relevant data for the single observations. Since the TEPA catalogues are intended to be used together with the TYC[3] the user will have access to all published data of a particular star. The TYC and TEPA/A CD-ROMs and the TEPA/B when ordered from CDS will be accompanied by some index files giving a two level indexing of the complete

[3]The TYC contains a field telling the user whether there are single observations available in TEPA/A or TEPA/B

catalogue and its Annex. These index files might be used by a quite simple program to get very fast access to the data of a particular star in TYC and TEPA if one knows the TYC-number (where TYC1 and TYC2 are identical to the GSC number for that star). A more user friendly access should also give the possibility to retrieve the catalogues via coordinates and to produce something like maps from TYC and light curves from TEPA data. Such possibilities are provided by CAT_{MAP}^{TRANS}

3. Core Routines and Catalogue Interfaces

The core routines of CAT_{MAP}^{TRANS} are written in IDL; they use common structures for data exchange and keywords for customising their behaviour. There are catalogue mapping routines which are capable of producing maps, catalogue overlay maps, and image overlay maps. There are a number of selection and coordinate conversion routines as well as an interface to DSS-fits files as produced by the ESO on-line DSS. The routines are virtually independent of the underlying catalogue due to the usage of interface routines between the catalogue input and the internal data structures of CAT_{MAP}^{TRANS}. All the routines are also usable as stand-alone routines and any new routine might use a common initiallisation routine yielding access to the common structures. The access to catalogues is not part of the core routines, but belongs to the catalogue interface. Thus CAT_{MAP}^{TRANS} is able to use every catalogue if the interface routine fills up the common data structure. Due to the flexibility of IDL, interface routines may be written in C, Perl and/or FORTRAN. The catalogue interfaces are responsible for the correct contents of the common structures. Since every catalogue has its special contents some of the core routines are also able to provide access to the complete catalogue information for every object on a map produced from the selected catalogue. The main advantage of using IDL as the programming language of CAT_{MAP}^{TRANS} is the very good portability of IDL-code. This is even enhanced by some special environment files used by CAT_{MAP}^{TRANS} describing the path- and file-names of the available catalogues. The core routines only use string variables for accessing files on the local file-system and are thus independent from file name conventions of the operating system. New catalogues may be easily added to CAT_{MAP}^{TRANS} through some preparation tools providing the interface routines.[4]

4. User Interface

The main user interfaces to the core routines are IDL-widget-based GUIs. They build an easy-to-use layer above the core routines and a offer most of their capabilities by mouse interaction. There are two main GUIs: one for the TYC and other star catalogues and another for the TEPA catalogues. Both are usable as stand-alone interfaces and as an integrated tool. Thus it is possible, for instance, to create a Bright Star Catalogue (BSC) map with an overlay from TYC. By clicking on a star on the map, the TEPA observations for this star will

[4] one of these tools is using a description file for the columns of a catalogue in order to produce an IDL-interface routine

be loaded and the TEPA window will gain control. A click on a button on the latter will pop up an additional window which allows some interactive period investigation by means of a periodogram routine, a minimum entropy routine, and, of course, some plotting routines to visualize the results.

5. WWW Interfaces

The other user-interface to the core routines is WWW-based and runs on every browser that has form and client-side image map capability. There are some simple HTML-forms which ask for coordinate or TYC number input plus some auxiliary input, such as the diameter of the map to be produced. The `<SUBMIT>` button will send this query to the HTTP-server. The underlying CGI mechanism produces an IDL routine from the query string and runs IDL with this routine as a startup file. The output to the HTTP-server and thus the user is of NPH-HTML type importing a GIF-image of the requested part of the sky. The HTML code contains data to describe the image as a client-side image map, merely the TYC-numbers of the stars on this image. A click onto the map will result in a query to another CGI-interface producing a list of all transits of the star closest to the click position. This interface is currently being updated to a functionality comparable to the IDL widget GUI.

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References

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