Digitization of Astronomical Photographic Plates

M. Tsvetkov[1] K. Tsvetkova[2] N. Kirov[2,3]

[1]Institute of Astronomy and National Astronomical Observatory, Bulgarian Academy of Sciences

[2]Institute of Mathematics and Informatics, Bulgarian Academy of Sciences

[3]Department Informatics, New Bulgarian University

Konkoly Observatory, 20.10.2011

Outline

FITS Format File

- FITS or Flexible Image Transport System is a digital file format used to store, transmit, and manipulate scientific and other images.
- A major feature of the FITS format is that image meta-data is stored in a human-readable ASCII header.
- Each FITS file consists of a header containing ASCII card images (80 character fixed-length strings) that carry keyword/value pairs and an image data block.
- The official reference document that defines the requirements for FITS format data files for 3.0 version is published in Astronomy and Astrophysics, Volume 524 (December 2010).

FITS Header Standard

Our FITS header is based on *AIP Archive of historic Carte du Ciel scans* (`vo.aip.de/plates`)

- *Demonstration:* `header_st.xls`

The abbreviations in the first column of the table mean:

- `fixed`: the value is fixed in case of plates
- `md`: the value is copied from the WFPDB – **maindata** file
- `not`: the value is copied from the WFPDB – **notes** file
- `obser`: the value is copied from the WFPDB – **observers** file
- `cat`: the value is copied from the WFPDB – CWFPAs file
- `calc`: the value is obtained by calculation
- `man`: this value must be inserted manually
- `tif2fits`: the value will be replaced by **tif2fits**

FITS Header Tool

- In parallel of scanning plates, we have to create the FITS header.
- This software tool uses the data stored in WFPDB.
- *Demonstration:* `header2011.exe`

tif2fits

- `tif2fits` converts row-tif files (16-bits gray-scale), produced by VueScan, to FITS files
- The input data for a plate consist of image file (row-tif format) and header file (plain text).
- The values of the following fields are updated: DATE-SCN (the scan date and time), DATE (last change of file), NAXIS1 and NAXIS2 (image size).
- In case of scanning with a step wedge, the program separates wedge part of the image and produces two FITS files – one for the plate and one for the wedge.
- *Demonstration:* `tif2fits.exe`

Konkoly test

For the plate with WFPDB identifier `KON060 005018` the digitization system produces files with a prefix `KON060_005018` and the following extensions:

Extension	Size	Type	Produced by	Comment
`.jpg`	1.4M	color image	–	preview
`.tif`	477M	16bit gs image	VueScan	scan
`.hdr`	6K	text	header2011	header
`.fits`	440M	16bit gs image	tif2fits	plate
`.hdrf`	7K	text	tif2fits	header
`w.fits`	38M	16bit gs image	tif2fits	wedge

Application

Telescope	scale (arcsec/mm)	plate size (cmxcm)	resolution (dpi)	file size (MB)
POT015	138	20x20	2400	681
POT080	17	16x16	1600	193
BAM010C	338	16x16	2400	440
BON030	138	16x16	2400	440
HAR025C	167	20x25	1600	430
ROZ050	120	16x16	2400	440
ROZ200	13	16x16	2400	440
KON060	144	16x16	2400	440

Conclusions

The presented here software is a part of a technology (full pipe-line) for digitization of astronomical photographic plates. It speeds up the processing time and decreases the possibility of errors in the FITS header. Separating the plate image and the wedge is a new feature in such type of software. Improvements may go in several directions:

- to conform the FITS header to requirements of new FITS standard 3.0 (2010);
- to include validation rules for some fields in header software, especially for coordinates, numerical values, etc.;
- to implement the algorithm for calculating the coefficients for converting the local plate coordinates to the World Coordinate System.