

IX BULGARIAN-SERBIAN ASTRONOMICAL CONFERENCE:
ASTROINFORMATICS
2-4 JULY, 2014, SOFIA, BULGARIA

**WIDE-FIELD PLATE DATABASE: Software for Time
and Coordinates Conversions**

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Introduction

- Wide-Field Plate Database is WEB-based database that contains meta-data for more than 600 thousand plates.
- Over two million and half photographic plates are identified and collected in this database.
- To add new plates meta-data in WFPDB, the data must meet the requirements of content and structure of the data.
- The time of observation has to be in UT and coordinates have to be in J2000.
- The software can convert:
 - the time from local sidereal time or local time to universal time;
 - the equatorial coordinates from any equinox to J2000.
- The input and output files are in data format of WFPDB.

WIDE-FIELD PLATE DATABASE, <http://www.skyarchive.org/>

Wide-Field Plate Database

- The Catalogue of Wide-Field Plate Archives (CWFPFA) contains data for archives – the set of plates which are obtained with one telescope or camera at one place.
- In the actual version 7.0 (June 2014) there are 495 archive descriptions. (<http://www.skyarchive.org/catalogue.html>, Cat7.0.xls)

	Description	Format	Example
1a	Instrument Identifier (obs.code and instr.aperture)	[LLLDDD]	ROB033
1b	Original Name of the Instrument		CdC Astrograph
2-3	Location of the Archive		Brussels Belgium
8	Time zone(main)	hours	1
9	Observatory longitude	deg min	04 21.5
10	Observatory latitude	deg min	50 47.9

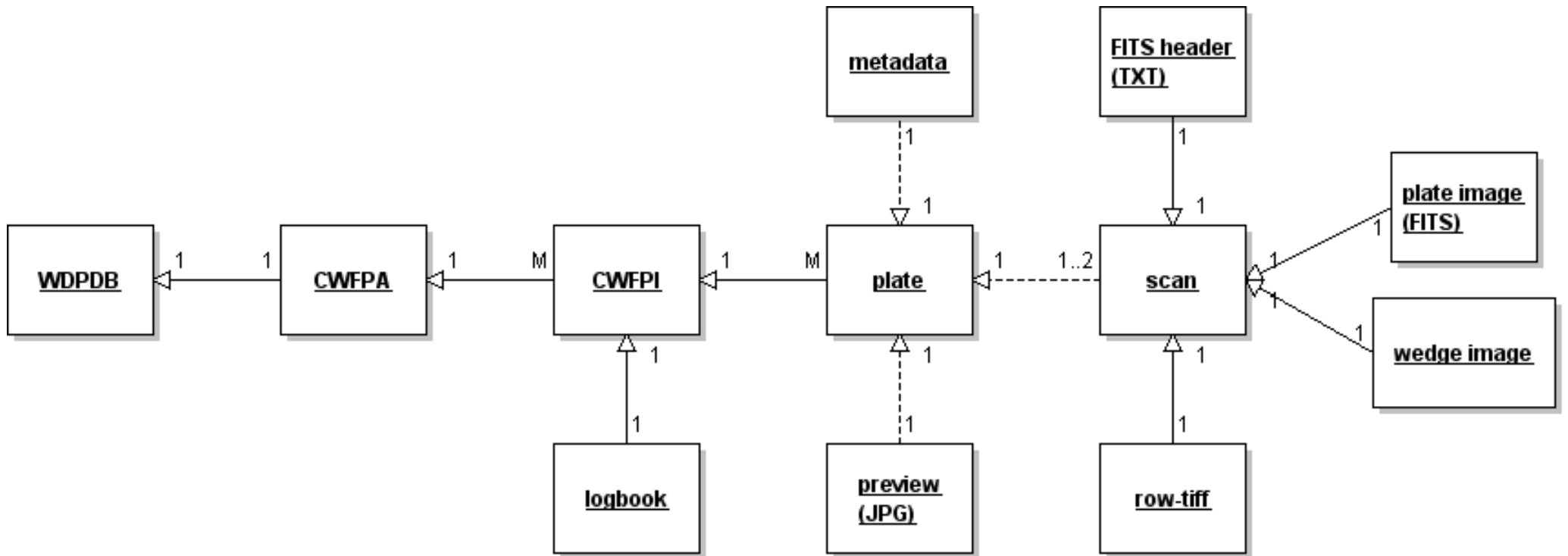
- Example:

ROB033 CdC Astrograph Brussels Belgium Royal Obs.Belgium Brussels Obs.

Uccle Belgium 12 1 04 21.5 50 47.9 105 0.33 3.43 60 Ast 2.6 1908 1950 110

T T.Pauwels

Wide-Field Plate Database



Main elements of WFPDB with their links.

Wide-Field Plate Database

- The Catalogue of Wide-Field Plate Indexes (CWFPI) contains meta-data for plates.
- Data for the plates are stored in the database:
 - the coordinates of the plate center,
 - the date and time of the observation,
 - object name and type,
 - method of observation,
 - duration of exposures,
 - type of emulsion,
 - the size of the plate,
 - the quality of the plate,
 - the name of the observer, etc.

WFPDB data format

- The meta-data of the plates are distributed in 6 plain-text files:
 - maindata;
 - quality;
 - observer;
 - availability;
 - digitization;
 - notes.

Example:

- ROB033maindata.txt
- ROB033quality.txt
- ROB033observer.txt
- ...

WFPDB data format

Example: ROB033maindata.txt

```
ROB033 000008 233256+333308 19081019214619
```

Positions		Description	Format	Example	
1-6	6	Instrument identifier	[LLLDDD]	ROB033	
7	1	Suffix	[] or [L]		
8-13	6	Plate number	[DDDDDD]	000008	8
14	1	Suffix for duplicates	[] or [L]		
15-20	6	Right ascension (RA)	[hhmmss]	233256	23 ^h 32 ^m 56 ^s
21-27	6	Declination (DEC)	[±ggmmss]	+333308	+33°33'8"
28	1	Missing data	[] or M		
29-36	8	Date	[yyyymmdd]	19081019	19.10.1908
37-42	6	Time	[hhmmss]	214619	21:46:19
43	1	Missing data	[] or M		

L denotes a capital letter; D denotes a digit.

Sources

There are different sources for gathering plate meta-data:

- telescope logbooks;
- photographic plates;
- plate envelopes;
- printed sources (books, plates' copies, etc.)

Time and coordinates

The most important data are coordinates of the plates center and time of observation. Usually

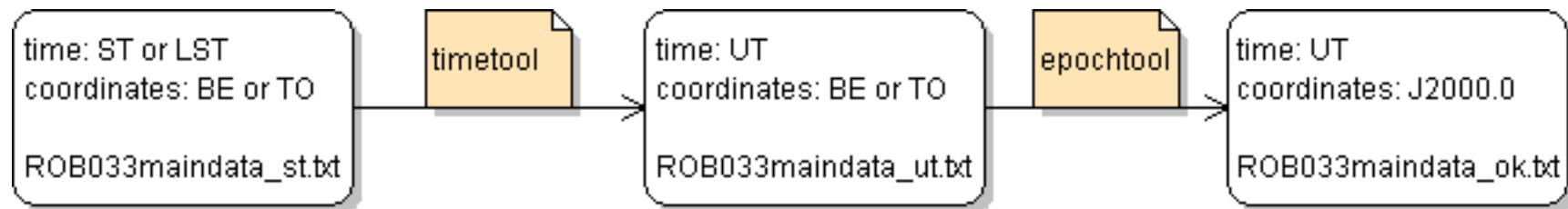
- the time is given as local sidereal time (LST or ST) or local time (LT), and
- the coordinates are in Besselian equinoxes (BE: B1875.0, B1900.0, B1925.0 and B1950.0) or in the time of observation (TO).

The WFPDB standard states:

- the time has to be Universal Time (UT);
- the equatorial coordinates have to be Julian equinox (J2000.0).

Time and coordinates

- `timetool` software transforms the time from local sidereal time (LST) or local time (LT) [local daylight saving time (DST)] to universal time (UT).
- `epochtool` software transforms equatorial coordinates (RA and DEC) from arbitrary equinox to J2000.



Conversion diagram.

For time conversion we use the approximation from [1] in (12), (13):

$$T_U = \frac{J - 2451545}{36524}$$

$$G = 24110.54841 + 8640184.812866T_U + 0.093104T_U^2 - 6.2 \times 10^{-6}T_U^3$$

$$U = L - \frac{G}{3600} - \frac{O}{15}$$

J – Julian day, G – Greenwich mean sidereal time, L – Local Sidereal Time, O – Observatory latitude, U – Universal Time

[1] S. Aoki et al. (1982) The New Definition of Universal Time, *Astron. Astrophys.* 105, 359-361.

Timetool

- Input files:
 - config file: `timetool.cfg`
 - optional summer time file: `<instrument name>.dst`
 - data file: `<dir><instrument name>maindata_st.txt`
 - catalog file: `<dir>Cat<version>.txt`
- Output files:
 - config file: `timetool.cfg`
 - data file: `<dir><instrument name>maindata_ut.txt`

Timetool

Configuration file for the example: timetool.cfg

```
2
ROB033
Cat7.0
0
../../astroinformatics/data/
```

Time Zone and Daylight Saving Dates for location:

<http://www.timeanddate.com/time/change/>

Summer time file BAL080.dst (Baldone Schmidt, Riga):

1987-03-29	03:00:00	1987-09-27	02:59:59	3	4	UTC+4h	MSD
1988-03-27	03:00:00	1988-09-25	02:59:59	3	4	UTC+4h	MSD
1989-03-26	03:00:00	1989-09-24	02:59:59	3	3	UTC+3h	EEST
1989-09-24	03:00:00	1989-12-31	23:59:59	3	2	UTC+2h	EET
1990-03-25	03:00:00	1990-09-30	02:59:59	2	3	UTC+3h	EEST

Timetool

Time contertion tool, v.1.2, 20.06.2014 [?] [X]

Local Time to Universal Time | Sideral Time to Univesral Time

LT --> UT | ST --> UT

Input file name: maindata_st.txt

Output file name: ROB033maindata_ut.txt

Catalog file name: .txt

Observatory: [v]

Time zone; longitude: 1; 04 21.5

Directoty:

Epochtool

The formulas can be found in:

`dlastro.gsfc.nasa.gov/ftp/pro/astro/premat.pro`

- Input files:

- config file: `epochtool.cfg`

- data file: `<dir><instrument name>maindata_ut.txt`

- Output files:

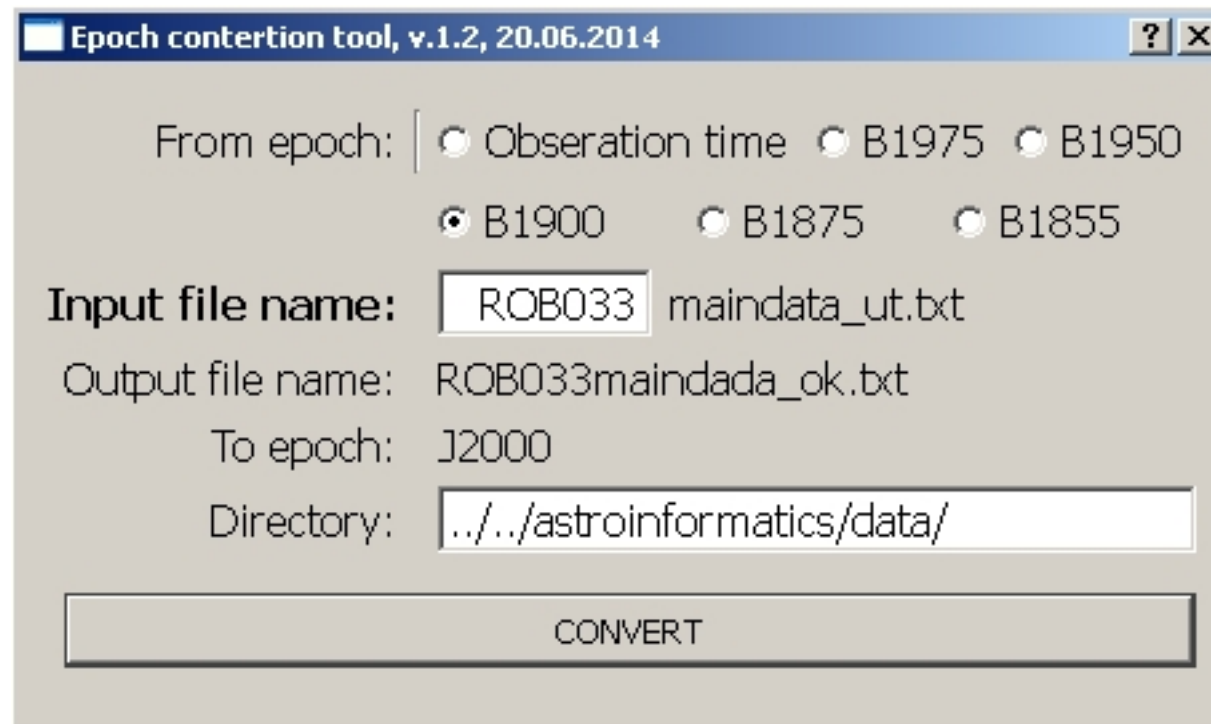
- config file: `epochtool.cfg`

- data file: `<dir><instrument name>maindata_ok.txt`

Epochtool

Configuration file for the example: epochtool.cfg

```
0 0 0 1 0 0
ROB033
../../astrophysics/data/
```



Conclusion

Example:

Original data: ST, B1900.0

```
ROB033 000008 232800+330000 19081019235400
```

Converted data: UT, J2000.0

```
ROB033 000008 233256+333308 19081019214619
```

The software is written in C++ using Qt – cross-platform application and UI development framework (<http://qt.digia.com/>).

- <https://github.com/nkirov/timetool>
- <https://github.com/nkirov/epochtool>

<https://github.com/nkirov/timetool>

<https://github.com/nkirov/epochtool>

Thank you for your attention.

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