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 (CWFPA) 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`)

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|	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 11(
  T T.Pauwels

Wide-Field Plate Database
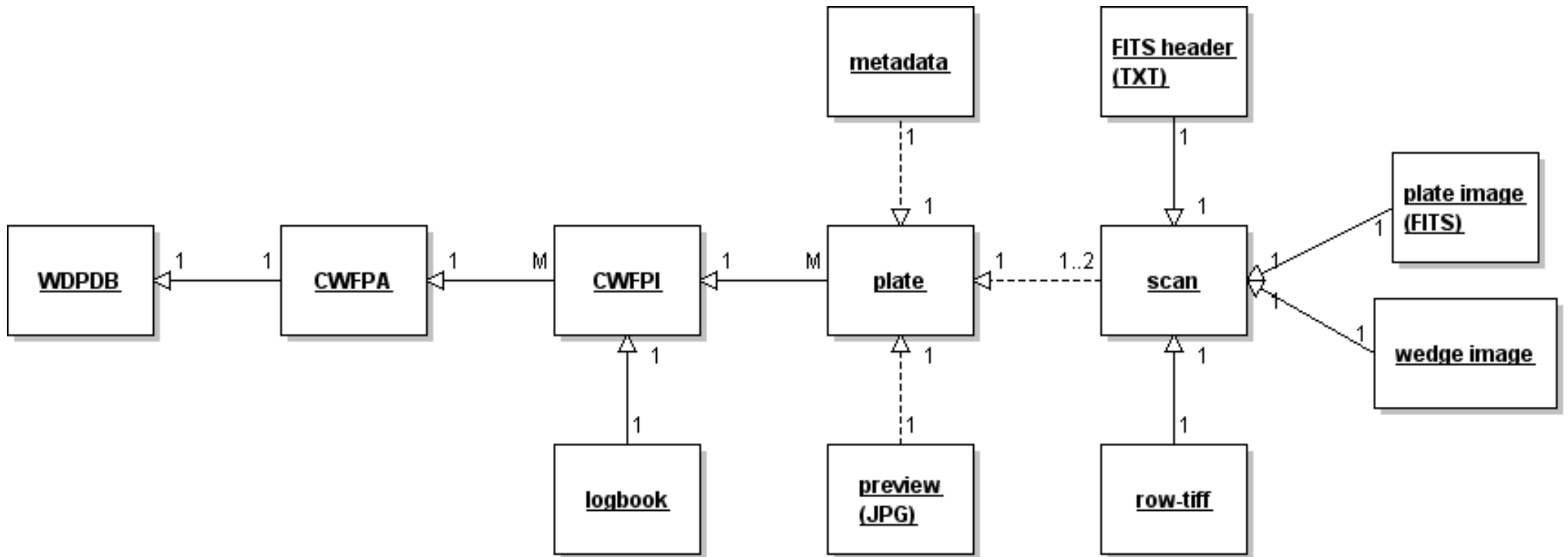
Main elements of WFPDB with their links.

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		Sufffix	[ ] 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	$23^h32^m56^s$
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
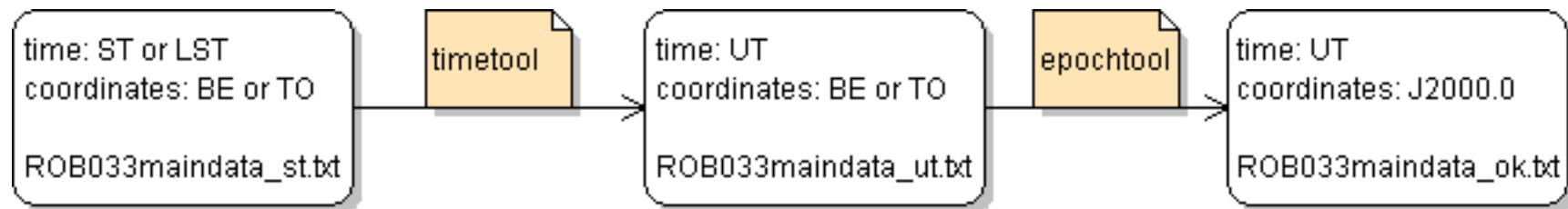
- the time is given as local sidereal time (LST or ST) or local time (LT), and

- 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.

| time: ST or LST
coordinates: BE or TO

ROB033maindata_st.txt | timetool → | time: UT
coordinates: BE or TO

ROB033maindata_ut.txt | epochtool → | time: UT
coordinates: J2000.0

ROB033maindata_ok.txt |

Conversion diagram.

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

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

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

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

$J -$ 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: `<instrunent name>.dst`

  - data file: `<dir><instrunent name>maindata_st.txt`

  - catalog file: `<dir>Cat<version>.txt`

- Output files:

  - config file: `timetool.cfg`

  - data file: `<dir><instrunent 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

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><instrunent name>maindata_ut.txt`
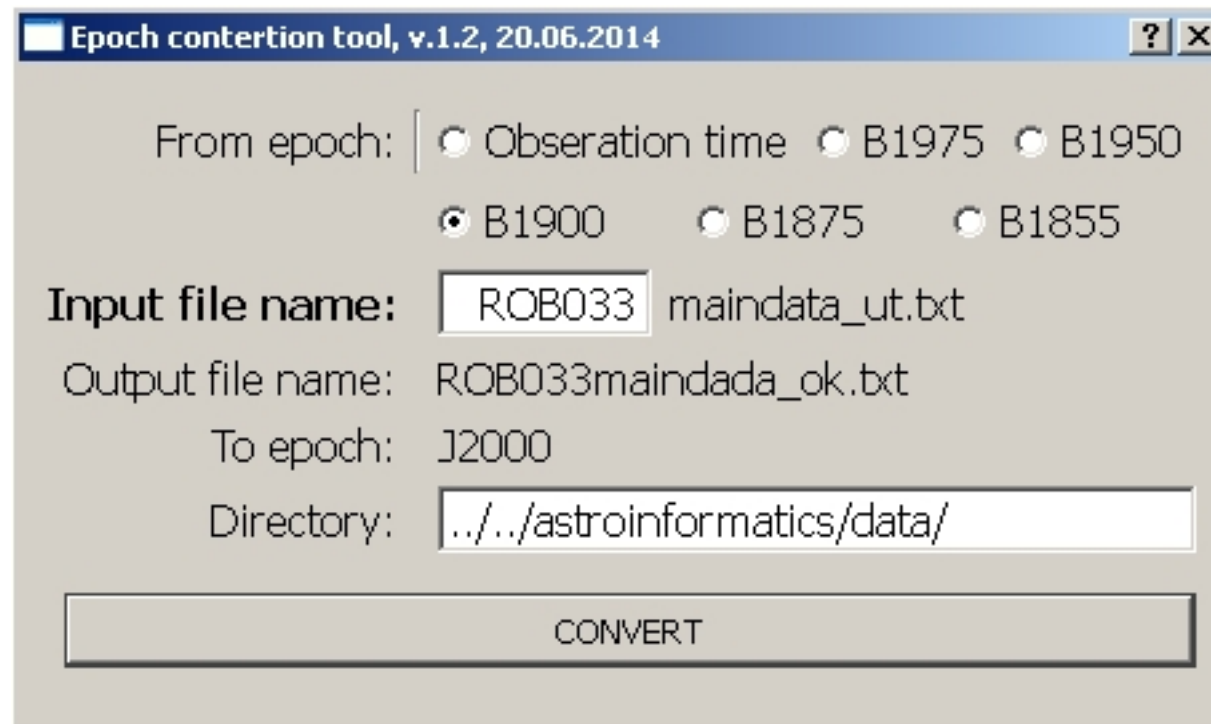
- Output files:

  - config file: `epochtool.cfg`
  - data file: `<dir><instrunent name>maindata_ok.txt`

Epochtool

Configuration file for the example: `epochtool.cfg`

```
0  0  0  1  0  0
ROB033
../../astroinformatics/data/
```


Epoch contertion tool, v.1.2, 20.06.2014   ? ✕

From epoch: ○ Obseration time ○ B1975 ○ B1950

● B1900   ○ B1875   ○ B1855

Input file name: ROB033 maindata_ut.txt

Output file name: ROB033maindada_ok.txt

To epoch: J2000

Directory: ../../astroinformatics/data/

CONVERT

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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