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

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- 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.

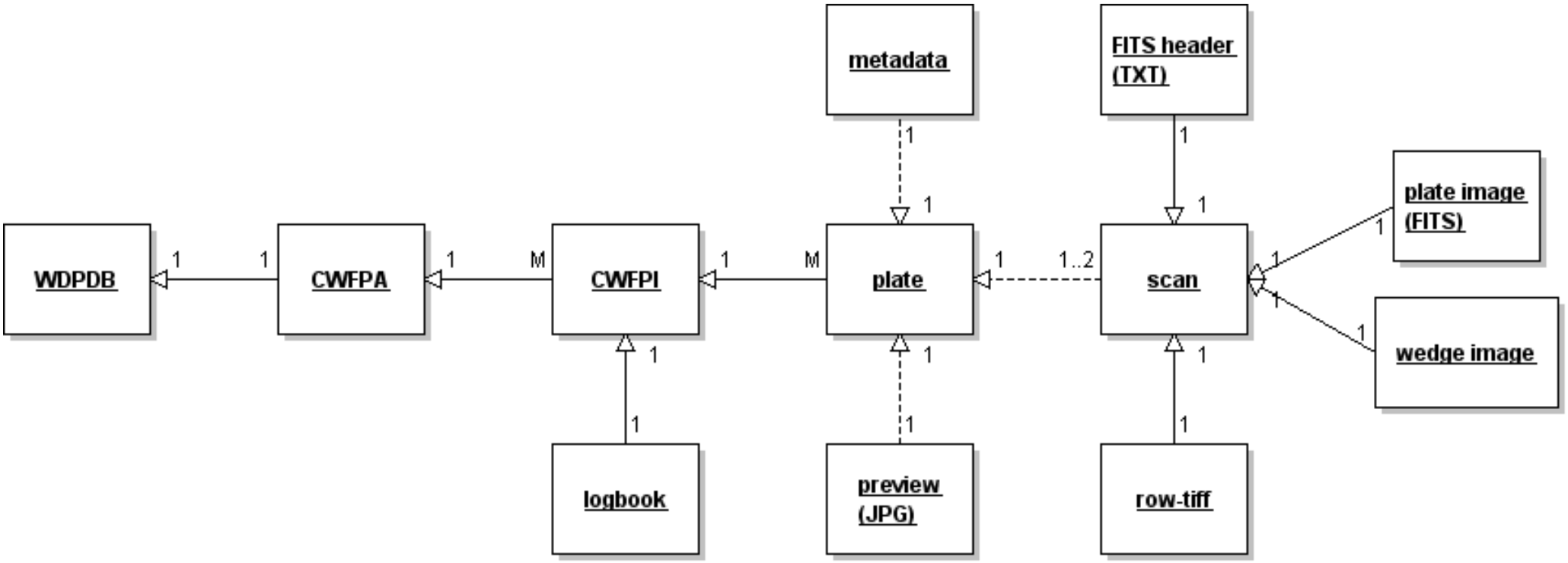
WIDE-FIELD PLATE DATABASE, `http://www.skyarchive.org/`

- 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`)

	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
```



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`
- ...

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	$+33^\circ33'8''$
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.)

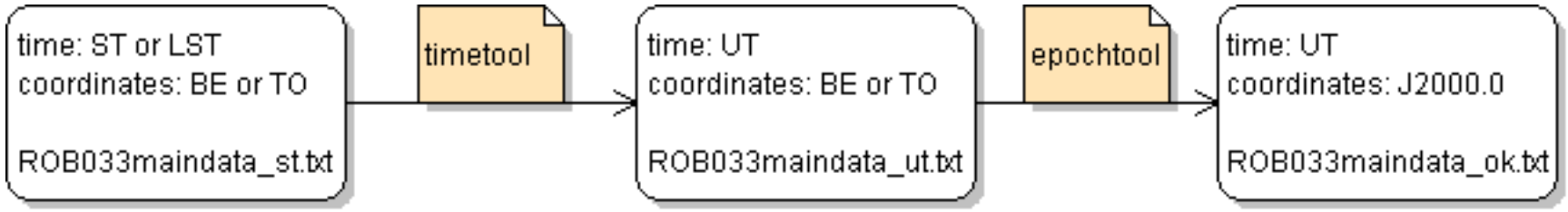
The most important data are coordinates of the plates center and time of observation. Usually

- 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).

- `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):

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

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

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

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`

Configuration file for the example: `timetool.cfg`

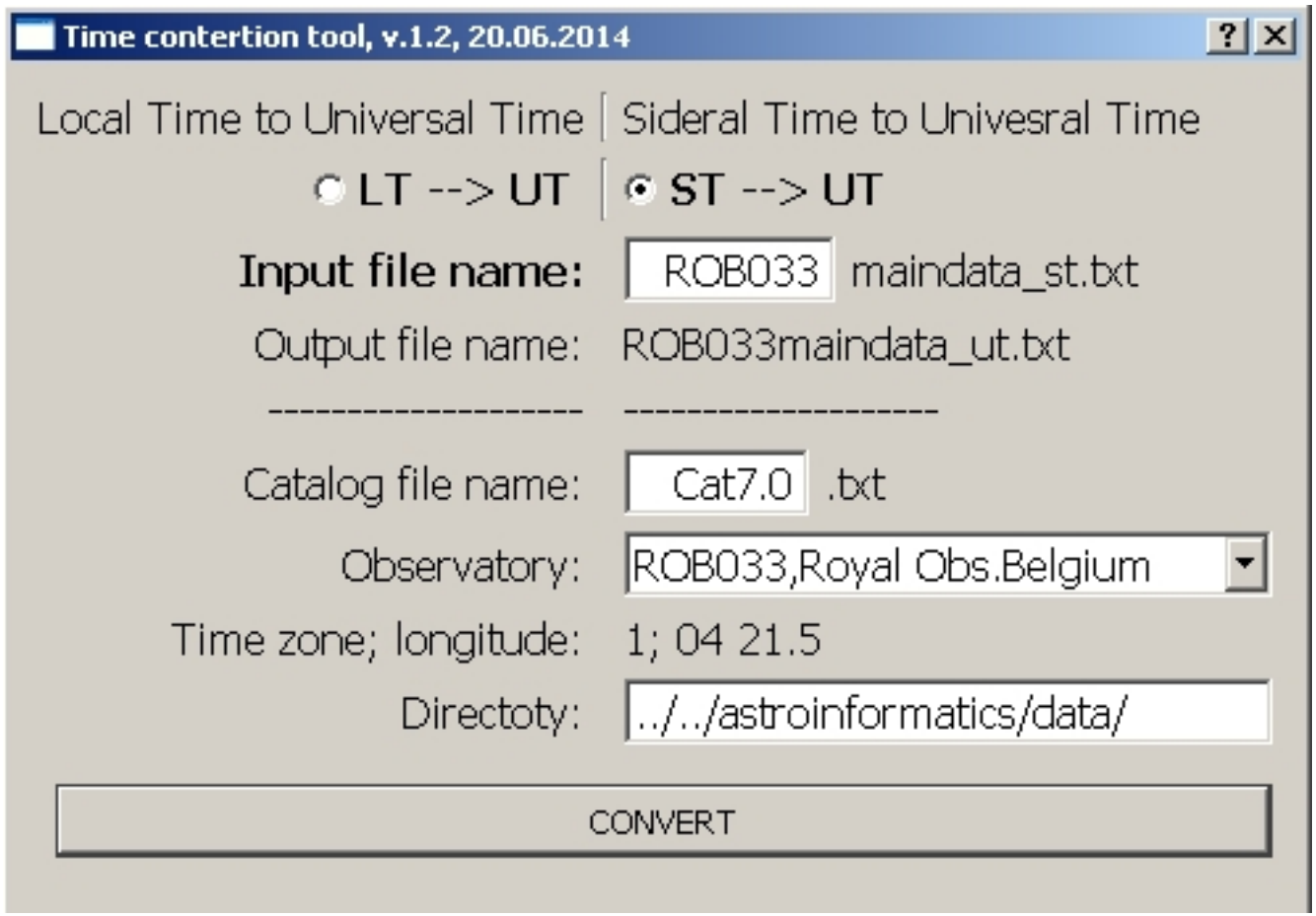
```
2
ROB033
Cat7.0
0
../../astroinformatics/data/
```

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
```

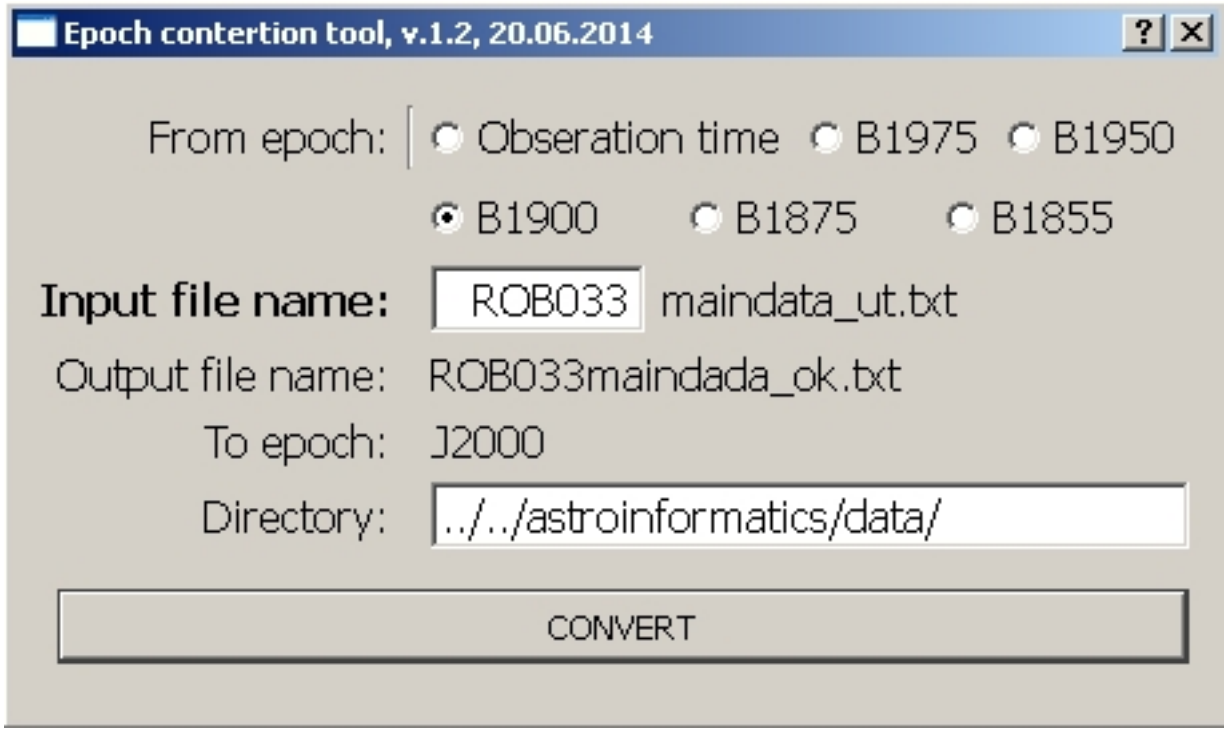

Time contertion tool, v.1.2, 20.06.2014
Local Time to Universal Time
Sideral Time to Univesral Time
LT --> UT
ST --> UT
Input file name:
ROB033
maindata_st.txt
Output file name:
ROB033maindata_ut.txt
Catalog file name:
Cat7.0
.txt
Observatory:
ROB033,Royal Obs.Belgium
Time zone; longitude:
1; 04 21.5
Directoty:
../../astroinformatics/data/
CONVERT

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`

Configuration file for the example: `epochtool.cfg`

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



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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