Software Tool for Time Conversion in the WFPDB

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Introduction

- ASTROINFORMATICS: The processing of large amount of astronomical data.

- Wide-Field Plate Database (`http://www.wfpdb.org/`) is WEB-based database that contains meta-data for more than 600 thousand plates.

- It is one wide-field unique telescope, giving access to unique photographic astronomical observations, done systematically in the period $1880 - 2000$!

- There are about $2\,475\,000$ photographic plates all over the world.

Content:

- Wide-Field Plate Database

- Sources

- Time and coordinates

- Timetool

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 7.1 (Nov 2015) there are 509 archives records from 163 observatories.

Example: One record of CWFPA (`http://www.wfpdb.org/data/Cat7.1csv.csv`)
```
BAM009B,,Ernostar (92/166/1246),Bamberg,1,Germany,Remeis Obs.,
Remeis Obs.,a,Bamberg,Germany,521,1,10 53.4,49 53.1,288,,0.09,
,0.17,1246,Cam,38,1957,1961,,520,,,T,,,A,U.Heber
```

	Description	Format	Example
1a	Instrument Identifier	[LLLDDD<L>]	BAM009B
4b	Observatory Name		Remeis Obs.
8	Time Zone	hours	1
9	East Longitude	deg min	10 53.4
10	Latitude	deg min	49 53.1

`L` denotes a capital letter; `D` denotes a digit.

Wide-Field Plate Database

- The Catalogue of Wide-Field Plate Indexes (CWFPI) contains meta-data for plates.

- Data for the plates stored in the database:

  - the coordinates of the plate center,
  - the date and time of the observation,
  - object name and type,
  - method of observation,
  - etc.

- The meta-data of the plates (CWFPI) are distributed in 6 plain-text files but the most important information is in the `maindata` file.

Example: `BAM009Bmaindata.txt`

Example: The first record (line) of the file `BAM009Bmaindata.txt`

```
Id: AAAAAABCCCCCCDEEEEEEFFFFFFFGHHHHHHHHIIIIIIJ
    BAM009B012839 230000+600000 19571018220304
```

Id	Positions		Description	Format	Example	
A	1-6	6	Instrument identifier	[LLLDDD]	BAM009	
B	7	1	Sufffix	[ ] or [L]	B	
C	8-13	6	Plate number	[DDDDDD]	012839	012839
D	14	1	Suffix for duplicates	[ ] or [L]		
E	15-20	6	Right ascension (RA)	[hhmmss]	230000	$23^h0^m0^s$
F	21-27	6	Declination (DEC)	[±ggmmss]	+600000	+60°00'00''
G	28	1	Missing data	[ ] or M		
H	29-36	8	Date	[yyyymmdd]	19571018	18.10.1957
I	37-42	6	Time	[hhmmss]	220304	22:03:04
J	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.

- The time in the sources is given as Local Sidereal Time (LST or ST), or Local Time (LT), or even as Julian Dates (JD).

- The coordinates are in Besselian equinoxes (BE: B1875.0, B1900.0, B1925.0 and B1950.0) or in the time of observation (TO).

Time and coordinates

To add new meta-data for plates in the WFPDB, the format of data must meet the requirements of content and structure of the WFPDB.

- The time of observation has to be Universal Time (UT).
- The coordinates of the center of plate have to be Julian equinox J2000.

Our software transforms the time from local sidereal time, local time or Julian dates to UT and equatorial coordinates from any equinox to J2000 using the data format of WFPDB.

Time and coordinates

- `timetool` software transforms the time from local sidereal time (LST) or local time (LT) [local daylight saving time (DST)] or Julian dates to universal time (UT).

- `epochtool` software transforms equatorial coordinates (RA and DEC) from arbitrary equinox to J2000.

```
┌─────────────────────┐   timetool  ┌─────────────────────┐   epochtool  ┌─────────────────────┐
│ Time: ST or LT or JD │─────────────▶│ Teme: UT             │──────────────▶│ Time: UT            │
│ Coordinates: BE or TO │             │ Coordinates: BE or TO │              │ Coordinates: J2000  │
└─────────────────────┘              └─────────────────────┘               └─────────────────────┘
```

Conversion diagram.

N. Kirov, M. Tsvetkov, K. Tsvetkova, WFPDB: Software for Time and Coordinates Conversions, In: Proc. IX BSACA.

Data input file: maindata, for example `BAM009Bmaindata.txt`
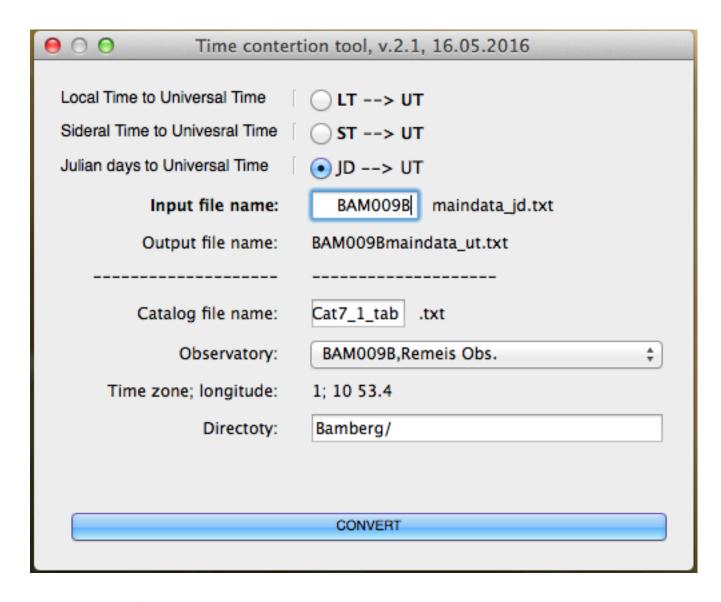
Configuration file for the example: `timetool.cfg`

```
2
BAM009B
Cat7_1_tab
0
Bamberg/
```

Time Zone and Daylight Saving Dates for location:

`http://www.timeanddate.com/time/change/`

Summer time file `BAL080.dst` (Baldone Schmidt, Latvia, 22 000 plates):

```
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
```
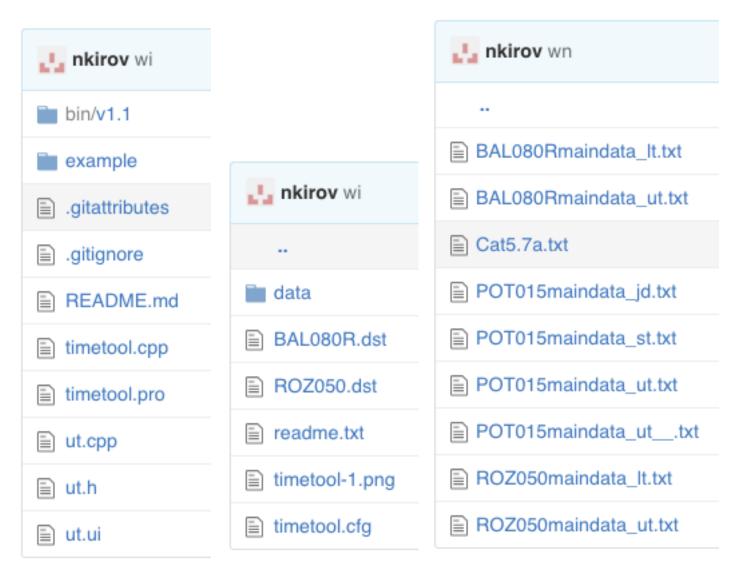
Timetool − user interface

Timetool

Example:

Original data: `BAM009Bmaindata_jd.txt` − JD

`BAM003 002999 104000+630000 2426452.365`

Converted data: `BAM009Bmaindata_ut.txt` − UT

`BAM003 002999 104000+630000 19310420204536`

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

- `https://github.com/nkirov/timetool`

Timetool – `https://github.com/nkirov/timetool`

Thank you for your attention.