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ASTROINFORMATICS AND DIGITIZATION OF ASTRONOMICAL HERITAGE

Abstract. The new interdisciplinary area of Astroinformatics combines scientific knowledge from astronomy and Information and Communication Technologies (ICT), based on Internet developments. Recently, four institutes of the Bulgarian Academy of Sciences launched a joint project called "Astroinformatics" and aimed at the development of the necessary methods and techniques.
Keywords: Astroinformatics, Information and Communication Technologies, Astronomical Photographic Plates, Astronomical Logbooks, Digitization

Introduction

Astroinformatics has arisen from the need of ICT methods for preservation and exploitation of the scientific, cultural and historic heritage of astronomical observations. Two data sources are main objects of the ICT developments:

- Metadata for photographic plates.

The Wide-Field Plate Data Base [4] (WFPDB) is an ICT project, which has been launched in 1991, by the working group "Wide-Field Sky Surveys" of the International Astronomic Union and is unique by its nature at international level (see [1], [2]). WFPDB improvements and additions are now under development in the frame of the current project. The wide-field photographic observations are some of the main information sources in astronomy, especially for events dating back in time. There are about 2 million plates stored in the astronomical archives worldwide, as an outcome of the work of more than 400 professional wide-field telescopes for more than a century. Now WFPDB contains metadata for over 500000 astronomical photographic observations. The digitized photographic plates are irreplaceable sources for

- studies of the stellar long term brightness changes, as a result of observations conducted in different observatories;

- studies of the long term variability of active galaxies;

- searching and identification of potentially hazardous asteroids and comets which might cause catastrophic events by their collision with Earth.

- Digitization of photographic plates.

So far 150000 photographic plates have been digitized through several European research programs. Advanced technologies for digitization photographic plates and also astronomical logbooks are included in this project.

The Project

The project "Astroinformatics: signal processing and analysis of digitized astronomical data and web-based implementation" joints four partner institutions in the Bulgarian Academy of Sciences: Institute of Mathematics and Informatics, Institute of Astronomy, Institute of Information Technologies and Central Laboratory for Geodesy. The

project team also includes members of National Institute of Meteorology and Hydrology - BAS, Sofia University "St. Kliment Ohridski", New Bulgarian University and Rakovski Defense and Staff College. International participations are Astronomical Institute and University Observatory, Jena and Astronomical Institute of the Czech Academy of Sciences, Prague (see [3]).

The main project objective is the usage of ICT methods and instruments for processing, representation and storage of astronomical images in specialized database for efficient data retrieval. The base project tasks are:

- Preservation, compression and access to wide-field astronomical observations;
- Virtual Observatory ICT standards compatibility, especially for platform independent operability [5];
- WEB-based search tools for stars in digitized observations;
- Adaptation of methods for image analysis, compression, web-access and data-mining;
- Dissemination among the ICT and astronomical community of the team experience.

The most important work packages (WP) of the project concerning digitization and preservation of astronomical heritage are WP3, WP4 and WP5.

WP3: Data storage & preservation

- Astronomical plate metadata preservation [4]

This task aims to set up a procedure for data preservation in the context of wide-field photographic plates. Having in mind the 15 years experience of the WFPDB team a procedure for entire work flow for plate data preservation will be establish. It includes detailed description of the plate observation catalogue preparation, the digitization procedure for obtaining both preview and high resolution images and preparation of table and image data for its implementation in a database.

- Image data storage

A reliable system for storage of enormous count of large astronomical images (Fig. 1) will be organized. It should have the capacity to hold the digitized plate archive of Rozhen National Observatory and plates digitized by the WFPDB team as a result of the participation in European scientific research programs too.

- Image database organization

The aim is the improvement of the existing WFPDB by adding and organizing an image database on the base of the currently digitized until now low and high resolution images. The objective within this task is also the relation of the newly created image database with the well established and active parts of the WFPDB – Catalogue of Wide-Field Plate Archives and Catalogue of Wide-Field Plate Indexes [2].

- Original logbooks data preservation (Fig. 2)

The logbooks contain metadata for astronomical photographic plates, written by the observers at the time of observations. The old observatories keep both the observations and the original logbooks of the telescopes. They keep valuable information for observational methodology and technology for photographic observations and are a part of historical and cultural heritage in Astronomy.

WP4: Virtual Observatory standards compatibility [5]

- Implementation of presentation and access protocols according to the accepted International Virtual Observatory Access standards
- Metadata standardization based on FITS header formalism

Based on EuroVO [5] metadata standardization and the world-wide recognized WFPDB table standard we are going to establishing a standard for description of digital images for astronomical photographic observations in regard to the accepted in astronomical community standards. An example in this direction is the FITS header, applied for the images in AIP Archive of historic Carte du Ciel scans [6].

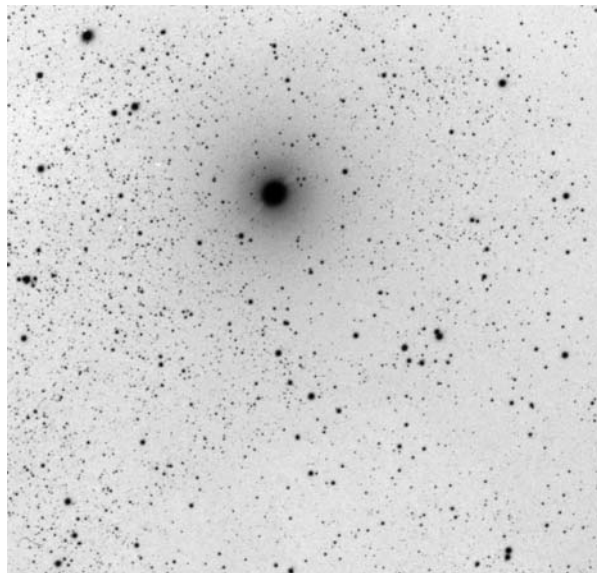- Applied software for standard FITS header extraction using existed catalogue and image information

Fig. 1: An example of a preview image

WP5: Web-based access

- Web-based access and catalogue visualization to the low-resolution (preview) images (small, with resolution up to 600dpi jpg color images).

Fig 2: An example of a catalog image [7]

- Web-based access and catalogue visualization to the high-resolution images (>1200dpi images for astronomical research projects in FITS file format, 16 bpi grayscale).
- Web-based access to the original telescopes logbooks (jpg images).

Conclusions

The main outcome of the current project is the preservation, storage, WEB-based fast access and dissemination of the available scientific and historical heritage of astronomical photographic wide-field observations on a national and European level. Especially a procedure of storage and exploitation of archive astronomical observation data will be established, including tables, registers and images with an implementation in the European observatories and European Virtual Observatory. Also a platform independent distributed database will be build, supplying unified access to accumulated digital images of wide-field astronomical photographic plates. This database can be associated to the European Virtual Observatory [5] for actual astronomical and interdisciplinary research.

References

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[6] AIP Archive of historic Carte du Ciel scans, http://vo.aip.de/plates/

[7] Harvard Observatory Plate Stacks http://tdc-www.cfa.harvard.edu/plates/a/logs/01b/

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