

THE SYSTEM FOR QUICK MONITORING OF ASTRONOMICAL PLATE ARCHIVES. MAIN PRINCIPLES AND PURPOSES.

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ABSTRACT. We propose to create a system for quick search and analyses of astronomical events and objects in plate archive of the Ukrainian Main astronomical observatory of NAS. The proposed idea of effective restoring of astronomic information is based on the treatment of the digitized plate archive as whole. The plates will be digitized by commercial scanner with optical resolution of 20 mkm and resolution on amplitude of 4096 grey levels. Such scanning parameters give the opportunity to receive the plate image files of the reasonable sizes suitable enough to identify the required object and to define its precise photometric characteristics. Connection of the system to Internet will allow a remote user to have access to plate images archive and to work with it. Modular structure of the system basic software and standard format of the plate image files allow future development of problem-oriented software for special astronomical researches by means of the cooperative projects.

Key words: Photographic plates: collections: data archives; photographic plate: digitization: methods; image processing: data bases.

1. Introduction

During the period when the photographic plates have been used in observational astronomy the world observatories have accumulated two, possibly up to three millions astronomical plates which have been processed only in a part accordingly to scientific task or not have been processed at all. Many of them contain the unique information about astronomical events or objects, registered at the moment of observation, but not call for till now. Among them are the variables of diverse nature, asteroids, comets and other Sun system bodies, optical sources in direction of gamma-bursts and other interesting objects. The information about this events or objects can not be obtained or restored

with the help of any modern facilities, space missions included, and so may be useful for many astronomical investigations.

The threat of astronomical plate archive loss caused by economical, technical or some other causes have put before world astronomical community a problem: the preservation of the unique information kept on those plates. The problem is solving by transformation of the information from plates to digital forms and keeping it on electronic data medium. There are two approaches to the solution. The most widespread one till some recent years is the global scanning of plates with high spatial resolution by specially designed measuring machines. The digitization of a single plate with such machines takes several hours. Volumes of the received information run up to 100 Gigabytes for one plate. Processing and storage of such data volumes are technically complicated and expensive. However, not for all astronomical investigations such image sampling is necessary.

In nineties new digitizing technology based on flat-bed commercial scanners equipped with transparency extention had appeared (see for more information the proceedings of the International Workshop "Threshure-Hunting in Astronomical Plate Archives", 1999, Sonneberg). There are a lot of scanner models from different producers on the market with rather wide range of parameters to satisfy many of astronomical scientific tasks.

2. System concept and main principles

The proposed system for quick monitoring of astronomical plate archives is intended for quick looking up and analyses of astronomical events and objects in electronic archives of plate images. For effective restoring of historical astronomic information it is necessary to work with digitized plate archive as whole. In such case

the sizes of plate image files become very crucial. But they depend significantly from the parameters of digitization. So if the plates will be digitized by commercial scanner with optical resolution of 20 mkm and resolution on amplitude of 4096 grey levels it will allow to receive file-images with sizes not exceeding hundreds and even tens Megabyte (dependently on plate size). For effective work with archive of plate images special data base for all photographic plate collection is necessary

If the exact definition of coordinates of researched object will be necessary some other digitization methods can be used among which is the measuring with precise measuring machines like an automatic measuring complex PARSEC, automated coordinatometer "Askorecord" and so on.

So the main principles of proposed system for quick monitoring of astronomical plate archives may be formulated such as:

- The system is oriented on looking up and detection of astronomical events and objects that have been registered on plates but have not been found in previous researches.

- The hardware and software of the system allow receiving file-image of the plate with spatial resolution not above 20 microns and dynamical range up to 4096 grey levels.

- The database of plates, which permits operatively receiving of the information on availability of necessary area plates and their characteristics, is employed.

- The simultaneous access to the file-images of all plates of the necessary sky region is provided.

- The three-level software is constructed on a modular approach and will be gradually developed according to problems to be solved.

- The standard formats of file-images are used.

- Extended users access to archive of the file-images, databases and software by methods of modern information technology are intended.

3. Purposes and tasks

The first step is the development of the network-accessible database of the Ukrainian Main astronomical observatory of NAS plate collection. The plate archive of MAO is accounted more than 15000 astronomical plates, obtained during last 50 years which are good for the monitoring of astronomical events and objects. When a suitable scanner will be obtained the creation of plate-images electronic archive will begin with parallel development image database and software environment creations for archive fast viewing and carrying-out researches on its basis. The next step will be the organization of access to archive and its service software for the remote user. The connection to the international integrated electronic fund of

the plate-images (incorporated virtual observatory) is assumed. The scientific programs to be solved with the system for quick monitoring of astronomical plate archives are such as:

- Opening of new and missed astronomical objects in the Universe.

- Monitoring and searching for new and missed bodies of the Solar System, near-Earth asteroids included.

- Researching of flare and other variable stars.

- Looking up and research of optical objects in directions of gamma- bursts. - Informational support of the space projects.

4. Hardware and software solutions

The minimum hardware requirements are:

- The scanner with a capability of large format (up to 300300) slides digitization with optical resolution up to 1200 dpi (20 microns image sampling) and discrediting on amplitude up to 4096 grey levels (12 bits of an analog-digital converter).

- Connected to the scanner IBM PC compatible computer with the central processing unit not lower than eleron 800Mhz, RAM 256b, hard disk not less 10Gb, and recorder for CD-ROM.

- IBM PC compatible computer with the central processing unit not lower than a Pentium - III 800Mhz, RAM 512Mb, having RAID- massive by a volume 100-200Gb for storage of digital archive and astronomical researches on its basis.

- The Internet connection based on the leased line with throughput not lower than 64Kbit/sec.

The modular software will have three levels structure:

- 1 level - digitization of plates, preliminary processing and storing of plate image files.

- 2 level - work with digital archive, image processing, search and detection of astronomical events and objects.

- 3 level - remote users support.

The modular and extensible basic software and standard format of the file-images allow future development of the problem-oriented software for special astronomical researches by means of the cooperative projects

5. First results

Ten plates have been scanned on small format scanners to determine the revealing abilities at various parameters and conditions of scanning, coordinate and photometric errors of scanners. The selective analysis of the MAO NAS of Ukraine plate archive have been carry out and some hundreds plate have been selected for search and rediscovery of asteroids. On plates, received in 1950 - 1970, several traces from asteroids, for

the first time discovered in 1996- 1998, were found and measured.

The photometric characteristics of the images of NGC-6913 cluster stars on two plates of the Goloseev's double wide-angle astrograph have been determined. We have found very good conformity of photometric characteristics (obtained with external accuracy of $0^m.13$ and $0^m.15$) between the plates.

The positional accuracy with the certificated test-plate has been evaluated. It was found that there is the difference between X and Y pixel size caused by the difference of mechanical and optical discretization steps sizes, and the dependence of the pixel size from the distance between a plate and CCD line. The reproducibility of distances between objects was about ± 0.5 pixel.

5. Conclusion

The development of system for quick monitoring of electronic plate- images archives based on inexpensive commercial scanner with optical resolution of 20 mkm and resolution on amplitude of 4096 grey levels give us an opportunity to extract the unique historical information from astronomical plates. Such digitization parameters will allow to receive file-images of plates with sizes not exceeding hundreds and even tens Megabyte without compression. This files allow to identify required objects and to determine their exact photometric characteristics that permit to realize various astronomical investigations.

Acknowledgements. The authors are thankful to Organizing Committee for financial support.