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ON-LINE DATA HANDLING, PROCESSING AND ARCHIVING FOR THE TWIN WIDE-FIELD IMAGERS OF THE LBT

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Abstract. Due to the peculiarity of the Large Binocular Telescope optics (two 8.4 m mirrors on the same mounting), two wide-field imagers will be located at the prime foci of the telescope. The twin cameras will obtain an equivalent of two images of 6000×6000 pixels which will be read out in 10 s. Due to the number of pixels/s that will be produced by the twin cameras, the handling, archiving and reduction of data is a complex task. The solutions we think to adopt are introduced.

Key words: instrumentation: data handling – telescopes

1. INTRODUCTION

Two Wide-Field Imagers (WFIs) are designed to be located at the prime foci of the Large Binocular Telescope (LBT). The instrumental aspects of the LBT WFIs are described in Ragazzoni et al. (1999). The speed and the field-of-view covered by the instrument, combined with its location at the prime foci of a binocular 8 m telescope and with the size of the detector (an array of four 2048×4096 CCDs), make handling, archiving and reduction of data (i.e. the data management as a whole) a non-trivial problem to solve.

2. WFI/LBT INSTRUMENT AND DATA RATE

The LBT telescope (Hill & Salinari 1998) has the unique feature of two 8.4 m diameter light collecting areas mounted on the same mechanical pointing system. The focal ratio of each mirror is extremely fast (F/1.14). The field is corrected over about 0.5 degree in size, allowing optical performances in terms of 80% of Encircled Energy in about 0.22″. The CCD array is made up with four 2068×4096 CCDs which will be read out in 10 seconds using a 1 Megapixel/second controller with four video channels.

We can presume that the average exposure time will be about ONE minute. Obviously the data rate will be faster for the Flat, the Bias and so on. The rate will be lower (~10 min), if we want to obtain frames at the limiting magnitude. Of course this average exposure time can be obtained only if the automatic observation block is running in the telescope/instrument system. It is easy to estimate that, with 12 h observing time and an image reading rate of 64 Mb/min, a data rate of 92 Gb/night will take place from both instruments.

3. DATA MANAGEMENT FACILITY

To solve this not trivial problem both hardware and software of the Data Management Facility (DMF) must be well designed with proper dimension.

For this we propose to organize the DMF on the following subsystems: the Data Handling tool, the Quick-Look facility, the On-line Data Store, the Data Processing Pipeline and the Instrument Archive. For interaction with all these subsystems, a User Interface is required, which may coincide with the interface which controls the Instrument(s) and sends requests to the Telescope control system. Furthermore, a number of data interfaces between the following subsystems need to be defined: between the Telescope and the Instrument(s), between the On-line Data Store and the Archive and between the Archive and the external users. In the following, the basic tasks of the subsystems are defined:

- Data Handling Tool (DH): gathers data from both the Instrument(s) and the Telescope in raw format and builds FITS files,
- Quick-Look Facility (QL): allows to access to the raw images and to display them in real-time,

- On-line Data Store (DS): the staging area in which the acquired and processed data are stored before they are permanently archived,
- Data Processing Pipeline (DPP): a batch processing the data using the pre-defined "recipes": (1) the standard for the generic Guest Observers and (2) the survey-oriented,
- Instrument Archive: a (possible) permanent storage of the data for the Italian astronomical community to be accessed after the proprietary period on data is expired,
- User Interface: possibly coinciding with the look-and-feel interface of the instrument and the telescope control user interface.

In theory, the system is expected to work as follows: the Data Handling tool first gathers raw format data from both the Instrument(s) and the Telescope and then builds FITS files containing the observed images; furthermore it also allows the Quick-Look facility to access the raw images and displays them. The data in FITS format, once prepared by the Data Handling tool, are kept in the On Line Data Store. As a part of the data management, a processing facility is foreseen: a Data Processing Pipeline will be built, which will get data from the On Line Data Store and process them in batch mode using pre-defined processing "recipes", and then will store them back in the On Line Data Store. When all the processing is finished (at the end of the night), User Data media will be produced, which contain both raw and processed images.

A copy of the User Data media will be made, which will be kept at the LBT for backup purposes. At the same time, data could be transferred to an Instrument Archive, where they could be kept to be available for the astronomical community, once the proprietary period assigned to the observer (TBD by the LBT Corporation) expires. The implementation of the Instrument Archive is still TBD.

To obtain data handling, archiving and pipeline processing, a parallel multi-CPU process with share memory is very useful due to the high level of the bit/second rate. The raw images can be at first stored in the computer memory and then read through DH and DPP systems to reduce the I/O on the mass storage. The mass storage system must have enough I/O speed to allow it, and its size must be designed to face any problem which may arise from a disk crash. Moreover its size must be designed to face any problem which may arise from the unavailability of the computer and/or data archiving system (maximum 3 days, corresponding to about 300 Gb of data acquired). The solution currently considered is a RAID 5 disk array system of appropriate capacity. At the end the Data Storage should be able to make two copies of all data (both raw and reduced) which are produced during the day to avoid conflict with the scientific data acquisition.

It's easy to understand that we need a high performance system, but the main constraint is the budget, which is of fundamental importance for choosing the computer system. At present we suppose to use the Windows NT or Solaris multiprocessor system, and we are checking if is it possible to import a part of the IRAF software system which is needed for the on-line data reduction pipeline under the Windows NT system. This would maximize the use of commercial off-the-shelf (COTS) and/or stable public-domain software:

- Database management system (Oracle/Objectivity),
- Data processing environment (IDL, IRAF, Python),
- Libraries (FITSIO, etc...)

4. STATUS AND DEVELOPMENTS

Currently, the user and the system requirements are being identified. Also, we check if the data processing software is running under the Windows NT. If so, this operating system will be chosen. The next steps will be to create a parallel pipeline for the DH and the DPP and to use the simulated data to check the correctness of the DH design. Concerning the DPP, a working group is defining the best algorithms, the calibration plan and trend analysis for the LBT/WFI data. Finally, the archive of the instrument is still to be defined; this should be regarded as an important feature, since the WFI itself will become a facility instrument for the whole LBT project.

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