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JAstroCam - A New Tool for Data Gathering with CCD

M. Budyn[1], S. Zola[1,2] and K. Wojcik[3]

[1] *Astronomical Observatory of the Jagiellonian University, ul. Orla 171, 30-244 Cracow, Poland*
[2] *Mt. Suhora Observatory, Pedagogical University, ul. Podchorążych 2, 30-084 Cracow, Poland*
[3] *Pedagogical University, ul. Podchorążych 2, 30-084 Cracow, Poland*

Abstract. We present a new acquisition program for observations with CCD. The code is written in the JAVA language, currently supports Photometrics S300, SBIG, APOGEE and Andor CCDs. New hardware support can be extended by adding plugins for either a new type of CCD or a filter wheel. The software is capable of performing an on-line reduction of frames coming in real time either on non-processed or reduced for bias/dark/flat frames.

1. Introduction

The PMT-based photometers, very common in gathering photometric data several year ago, have been replaced by CCD detectors. Recently, due to their high QE, reaching 98% in the R band, decrease in cost and shorter readout time, most observatories use exclusively CCD with their telescopes. The software used to control the CCD operation allows to view the exposed frames in real time, however, usually does not support real time data reduction and the observer can judge the quality of the data only after some time, when the reduction of the scientific images taken at night has been processed. This can cause inefficient usage of available clear nights. An observer, seeing a light curve in real time, as it was common in the PMT-based photometers era, could adjust his target for a given night based on the weather conditions.

Two years ago, we undertook a project to create a software for astronomical data gathering with CCDs. The aim was the program can run under Linux OS, having an intuitive GUI, accurate timing and the possibility to see the light curve in real time.

2. Program Architecture

In most general form, JAstroCam is a scientific image acquisition tool. Even though it is possible to take any kind of exposures, its user interface as well as built-in functions, are highly optimized for being used by astronomers. JAstroCam can be divided into three layers that are separated by well defined abstract interfaces. The first, low-level, hardware dependent part consists of a device modules that core application uses to communicate with the CCD hardware and other telescope hardware. A future version will also add support for the dome and the telescope operation. The second part of the application is the system core that consists of data processing services and a user interface. The most important services are 'exposure engines' that control the image acquisition. The tool has possibility of having more than one engine e.g. to control the primary camera as well as a guiding camera in parallel. The third layer consist of external

modules (plugins) that are loaded at the application start-up. Plug-ins can enhance functionality of the application i.e. by providing additional image processing, more advanced exposure engine control, observation logging, weather reporting, etc.

JAstroCam is written entirely in JAVA and runs on any Java 6 Standard Edition compatible computer system. Therefore, it is compatible with almost any of widely used hardware platforms as well as operating systems, including Linux, Windows and Solaris. In the current release of JAstroCam, built-in device modules for cameras and filter wheels are only supported on the Linux platform.

3. Pratical usage of JAstroCam

JAstroCam currently supports Photometrics S300 CCD, SBIG, Apogee and Andor USB CCDs. Three filter wheel drivers are available: for SBIG, IFW and custom made, OAUJ filter wheel. With a fully graphical interface, the observer can set up and control hardware devices and schedule exposures. To perform the data acquisition, the user specifies an exposure set which describes requested observation sequence (i.e. filters, exposure times) in a very flexible way.

The on-line reduction can be set up when a template frame has been taken and the target, comparison and check stars are marked. At present, only aperture reduction is supported. Reducing the scientific images, the program follows the drifting stars. The reduced light curves are shown in a separate window, either as a magnitude differences or counts for all marked objects.

A special care was taken to ensure as accurate as possible time accuracy written in the header. Always the beginning of exposures are written, additionally also JD with the heliocentric correction of the middle exposure time is calculated and stored. The time is taken from the system clock and JAstroCam at start checks the correctness of the system time with preset time servers. A warning is displayed when inaccurate time has been recorded. The observer can also check the time accuracy at any time with a ”Check NTP time” plugin. Accuracy of JAstroCam timing has been checked against G117-B15A, a pulsating white dwarf which has been claimed to be the most stable optical clock ever found, much more stable than the ticks of an atomic clock (Kepler et al. 2000). Based on two short runs taken in spring 2009, accuracy of time written in the header was found to be better than 1 sec.

References

Kepler, S. O., Mukadam, A., Winget, D. E., Nather, R. E., Metcalfe, T. S., Reed, M. D., Kawaler, S. D., & Bradley, Paul A. 2000, ApJ, 534, L185