

Evaluating the Control Software for CTA in a Medium Size Telescope Prototype

CTA (Cherenkov Telescope Array) is one of the largest ground-based astronomy projects being pursued and will be the largest facility for ground-based gamma-ray observations ever built. The ALMA Common Software (ACS) distributed control framework has been chosen for the implementation of the control system of a CTA prototype telescope. The design of the control software is following the concepts and tools under evaluation within the CTA consortium, like the use of a UML based code generation framework for ACS component modeling, and the use of OPC Unified Architecture (OPC UA) for hardware access. In this contribution, the progress in the implementation of the control system for this CTA prototype telescope is described.

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The CTA array

The CTA array [1] will allow the sky to be probed in the very high energy domain from a few tens of GeV to more than a hundred TeV, extending the existing energy coverage and increasing by a factor 10 the sensitivity compared to current installations, while enhancing other aspects like angular and energy resolution. The CTA array will consist of more than 50 telescopes of at least three different sizes, deployed in two arrays (one in each hemisphere).

The control software

The ACS distributed control framework [2] is under evaluation to be used for CTA [3]. To provide a realistic benchmark of this framework for CTA, the control system of the MST will be developed with ACS. Other design concepts for the CTA array control system [3] will be tested as well: i) OPC UA servers for hardware access are created using the Prosys OPC UA Java SDK. ii) Mechanisms for bulk data transfer like DDS and ØMQ are being evaluated. iii) several existing technologies for data archiving are under examination. iv) To facilitate the creation of ACS components, a UML model based code generation framework (*Comodo*) [4], where the UML models are created using the MagicDraw UML modeling tool, is being tested.

The CCD cameras

Five Prosilica GC 1350 CCD cameras using a Gbit Ethernet interface will be installed in the prototype. These will allow the evaluation of the telescope structure stability, the mirror alignment procedures and the point spread function of the optical elements. Along with the weather station data the effect of environmental conditions will also be assessed. These CCDs, working at a 10 Hz exposure rate, will be the main source of data from the prototype. An SDK from Allied Vision Technologies permits the setup and control of the CCDs in a Linux environment. Preliminary versions of an OPC UA server and Java ACS components to control these cameras, as well as a video display application, have been developed. The CCD images will be stored in FITS format and organised using a document-oriented database.

The drive system

The drive system is designed to resemble the operation modes expected for the CTA telescopes. To test and to tune the drive system, as well as to exercise emergency situations, are the major tasks of the prototype. With the help of CCD cameras, dedicated fiducial marks will be measured and astronomical objects will be tracked. The drive will be operated by a Bosch-Rexroth PLC with VxWorks hosting an OPC UA server, thus allowing direct interface to the PLC to the control system via ACS under Linux. The first ACS components will be tested with two drive test stands (Fig. 2) in synchronous operation.



Fig. 2: One of the MST prototype drive test stands

References

- [1] CTA Consortium 2010, « Design Concepts for the Cherenkov Telescope Array », arXiv:1008.3703
[2] G. Chiozzi, et al., « The ALMA Common Software: a developer friendly CORBA based framework », SPIE Procs. 5496-23 (2004).
[3] P. Wegner, et al. « Simultaneous Operation and Control of about 100 Telescopes for the Cherenkov Telescope Array. » Poster on the Online Computing session (track 1) of CHEP 2012
[4] N. Troncoso, et al. « A Code Generation Framework for the ALMA Common Software », SPIE Procs. 7740-121 (2010)

The telescope prototype

A prototype for the Medium Size Telescope (MST) type is under development and will be deployed in Berlin during 2012. The MST prototype will consist of the mechanical structure, a drive system, mirror facets mounted with powered actuator to enable an active mirror control (AMC) system, several CCD cameras, a weather station and a dummy camera (Fig. 1). Emulated data sources will operate to generate the expected data rates from photo-multiplier cameras.

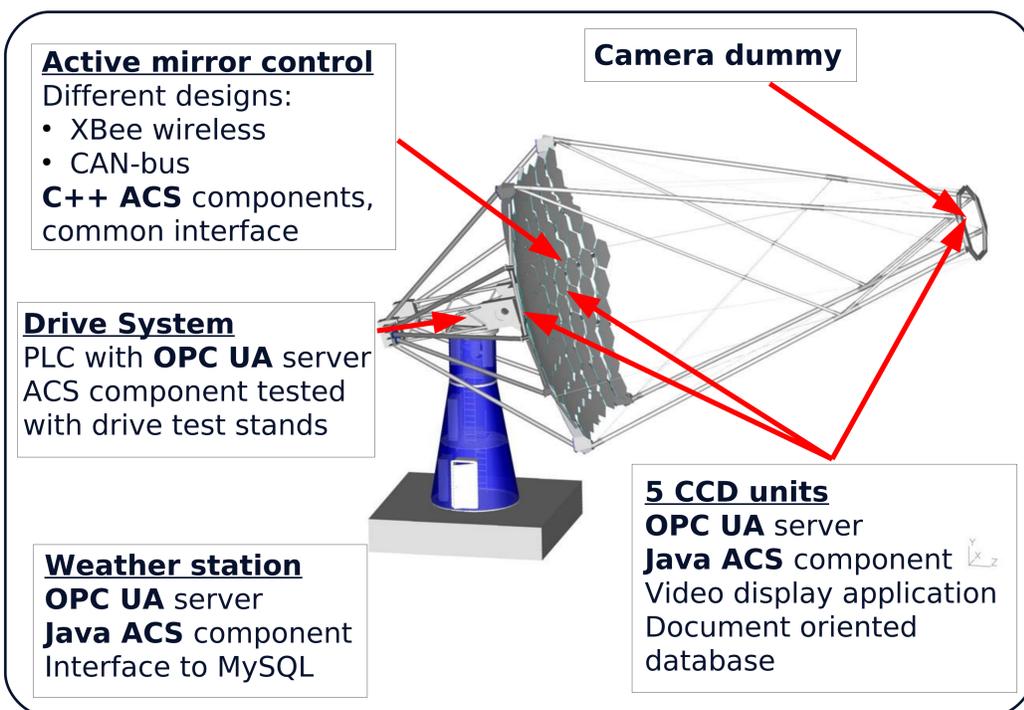


Fig. 1: MST prototype instrumentation

The active mirror control system

Units of two different AMC designs will be installed and tested in the MST prototype. One design uses Xbee wireless control, the other uses CAN-bus interfaces. It is envisaged that the control software of the AMC system will provide a common interface to both types within ACS. A C++ ACS component to control a unit of the Xbee AMC type has been developed and successfully tested, and a general solution to integrate the control of the whole system is under development.

The weather station

An OPC UA server allows the David Vantage VUE weather station to interface via RS-232. A Java ACS component has been created and, via an ACS Python client, data are stored on disk. An interface to a MySQL database is being implemented.

Conclusions

The development of the CTA MST prototype is providing a test bench for the control software of CTA, enabling the precise evaluation of the ACS software and the use of solutions like OPC UA servers and UML model based code generation of ACS components.

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