A Readout and Control System for a CTA Prototype Telescope

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CTA (Cherenkov Telescope Array) is an initiative to build the next generation ground-based gamma-ray instrument. The ALMA Common Software (ACS) distributed control framework has been chosen for the implementation of the control system of a CTA prototype. In the present approach, the interface to some of the hardware devices is achieved by using the OPC Unified Architecture (OPC UA). A code-generation framework (ACSCG) has been designed for ACS modeling. In this contribution the progress in the design and implementation of the control system for this CTA prototype telescope is described.

The CTA array

The CTA array [1] will allow studies in the very-high-energy domain in the range from a few tens of GeV to more than 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. These goals require the use of more than 50 telescopes of at least three different sizes. CTA will comprise two arrays (one in the Northern hemisphere and another in the Southern hemisphere) for full sky coverage and will be operated as an open observatory.

The Medium Size Telescope Prototype

A prototype for the Medium Size Telescope (MST) type is under development and will be deployed in Berlin at the end of 2011 or beginning of 2012. The MST prototype will consist of the mechanical structure (Fig. 2), a drive system, mirror facets mounted with active mirror control (AMC) system, four CCD cameras, a weather station and a dummy camera. Emulated data sources will operate to resemble a realistic operation scenario.

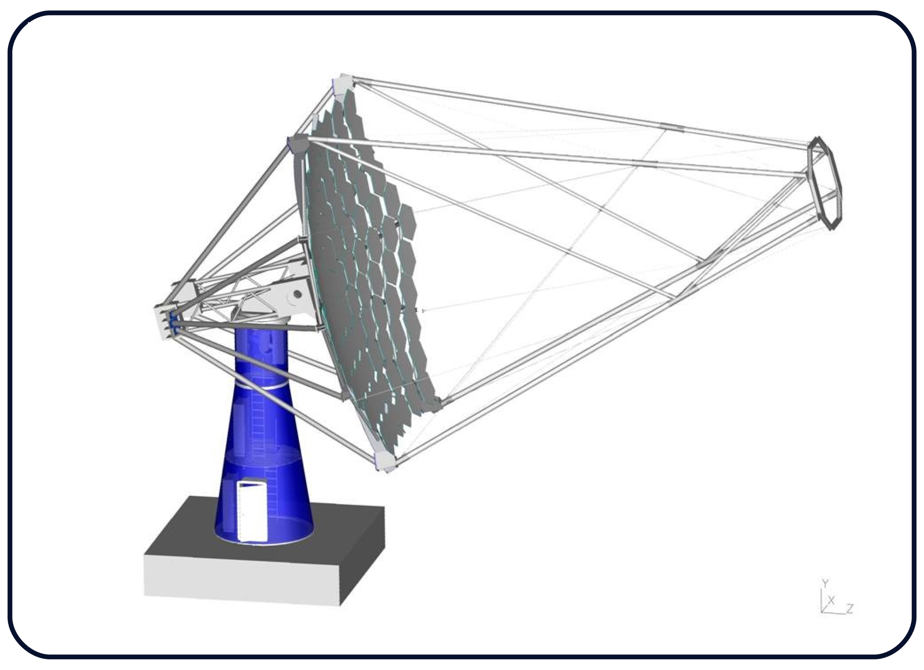

Fig. 2: Design of the MST prototype

The control software

Due to its size and complexity, CTA will require a flexible and powerful distributed control framework. The ACS distributed control framework [2], developed by the ALMA project and the European Southern Observatory (ESO), is a framework for distributed computing under evaluation for CTA. The CTA consortium is considering to define a standard way of accessing the hardware via OPC UA servers. The control system of the MST will be developed in the ACS framework and will use OPC UA servers acting as a *test-bench* for the design concepts for the CTA array control system. The ACS components are being generated with an UML model based code generation framework (ACSCG) [3]. The UML models for the ACSCG are created using the MagicDraw UML modeling tool on Linux. As a first example, an OPC UA server has been created to interface the weather station, and a Java ACS component for the prototype weather station has been generated and tested with the code generation framework (Fig. 1)

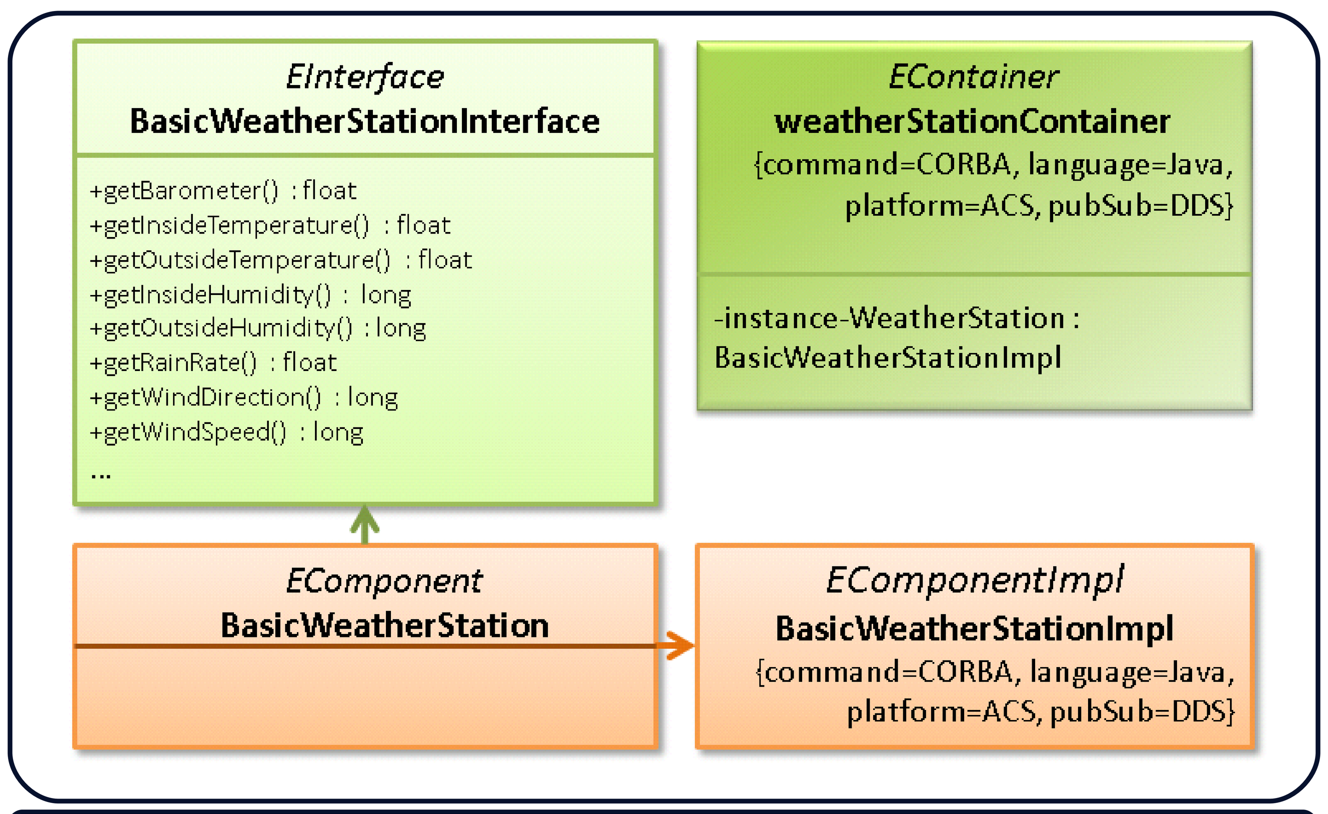

Fig. 1: The UML model for the weather station

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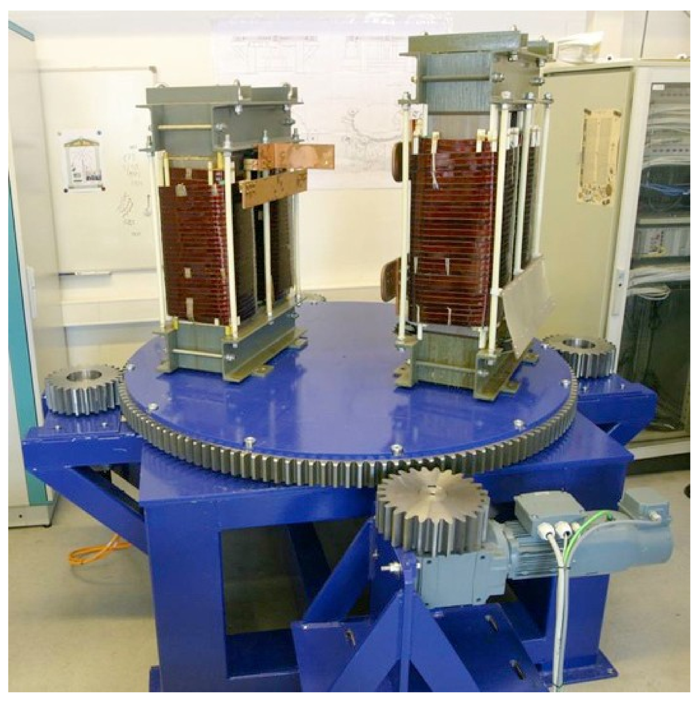

Fig. 3: MST prototype drive test stand

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 is one of 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 hosting an OPC UA server, thus allowing direct interface to the PLC to the control system via ACS under Linux. Earlier versions of the PLC firmware only provided an OPC DA server which required the use of Windows based wrapper software as an interface to Linux software. The first ACS components will be tested with the drive test stand (Fig. 3).

The CCD cameras

Four Prosilica GC 1350 CCD cameras using a Gbit Ethernet interface will be installed in the system. These will allow the evaluation of the telescope structure, the mirror alignment and the point spread function of the optical elements. Along with the weather station data the effect of environmental conditions will also be assessed. An SDK from Allied Vision Technologies permits the setup and control the CCDs in a Linux environment. ACS components will be created to control the CCD camera.

The active mirror control system

The telescope dish will be fully covered with both real and dummy mirror facets, which will be aligned by using AMC units. There are two AMC designs that will be installed and tested in the MST type prototype. One of the concepts uses XBee wireless and the other 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 Python ACS component has been developed and successfully tested for the XBee AMC type.

Conclusions

The MST prototype will provide 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.

References

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