Form 8

Research Result Report
ICRR Inter-University Research Program 2022

Research Subject: Development of the CTA/LST telescope control system

Principal Investigator: Ievgen Vovk

Participating Researchers: Masahiro Teshima, Koji Noda, Yoshiki Ohtani, Hyuga Abe

Summary of Research Result：

This project aims at implementing the central telescope control system (“Telescope Control Unit” or TCU) for first Large Size Telescope (LST1) of the CTA project, presently under commissioning at the Canary island of La Palma, Spain. TCU version, developed and deployed in FY 2020-2021, takes care of the low-level orchestration of the telescope subsystems and automatizes basic actions required to prepare the telescope for observations. A high-level interface implemented in TCU greatly facilitates the semi-robotic operations of LST1 (including the remote ones from the partner institutes in Japan) and enables its further integration into the CTA array control system.

In FY2022 developers from ICRR and the University of Geneva have extended TCU functionality to further automatize LST1 control and prepare it for the integration with the CTA array control and data acquisition (ACADA) system. Developers have also traveled to the LST1 site to ensure these changes are adequately integrated with the rest of the LST1 control environment. The applied modifications are outlined below.

Automatization:

- complete nightly LST1 observations schedule (from start up to observations and shutdown) was added to the AutoOperator. Telescope operators modify it as necessary according to the weather conditions and planned observational targets.
- high-level Telescope Manager component, orchestrating and synchronizing telescope’s Structure and Camera modules, was validated for telescope operations. Telescope Manager unifies LST1 control during regular observations and includes logic to optimally schedule Structure and Camera actions to maximize telescope observation time. It is presently used by LST1 operators on the daily basis.

- routine calibrations were allowed to be executed automatically whenever telescope has enough time before the start of the next observations block. Previously these had to be scheduled by the operators explicitly.
- Camera Manager's internal logic was redesigned to guarantee the consistent states of the underlying subsystems when exiting the encountered fault states. This is an major step towards the fully automatic recovery from camera faults; similar changes are planned to be applied to the Structure and Telescope Managers too.
- TCU now automatically reconfigures the camera as the sky brightness changes without stopping the on-going observations, improving data taking efficiency.

Integration with CTA central control:

- TCU interface was updated to the most recent version of the CTA-defined API.
- off-site testing environment for TCU and ACADA integration was prepared. TCU was prepared to be centrally deployed with ACADA as per CTA requirements.
- First read-only tests of ACADA at the La Palma IT center were performed successfully. Full TCU — ACADA integration tests are pending due to a delay in ACADA development.

No.	E08