

Research Report

ICRR Inter-University Research Program 2021

Research Subject: Development of the CTA/LST telescope control system
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Summary of Research Result : Purpose of this project is to develop 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 is expected to take care of the low-level orchestration of the telescope subsystems and automatize basic actions required to prepare the telescope for observations. A high-level interface implemented in TCU greatly facilitates the semi-robotic operations of LST1 and enables its further integration into the CTA array control system. In FY2021 ICRR team with the collaborators from the University of Geneva have implemented several substantial improvements to TCU, aimed at improvement of the (semi-)robotic LST1 operations. <u>Automatization:</u> <ul style="list-style-type: none">• "AutoOperator" TCU client has been added, able to perform the telescope control following the predefined schedule. This client also includes the interface to the external target-of-opportunity alerts and can autonomously re-point the telescope and start observations (though an alert confirmation by the operator is still required presently);• autonomous selection of the appropriate camera settings was added based

on the sky brightness of the observed region, improving the observations efficiency in complex conditions (e.g. the moonlit nights);

- routine calibration operations were fully automatized and the interface added to include the new ones under development by other teams;
- a preliminary problem detection logic was included with the found issues printed in the web-based TCU interface, facilitating their resolution by the operators.

Deeper subsystems integration:

- automatic mirror control (AMC) integration was completed and the required mirror adjustments are now performed during the observations by TCU automatically. Graphical user interface for AMC control was also included to the TCU web-interface and may be used in special cases when the manual mirror adjustments are required;
- camera lid control was added to TCU, so that it's automatically opened for observations and closed in the "standby" telescope state.

Interface improvements:

- a preliminary telescope "status" overview page has been added to the TCU interface, including the history plots of several critical "health" parameters;
- the "overall" telescope control API, compliant with the CTA observatory requirements, was added;
- revisions of this API were proposed addressing the issues identified during the LST1 operations. No critical issues for the future LST2-4 telescopes were found.

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