
MCAO testbed for European Solar Telescope (EST): first laboratory results for SCAO and GLAO configurations.

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Abstract

A Multi-Conjugate Adaptive Optics (MCAO) testbed has been developed at the Instituto de Astrofísica de Canarias (IAC) as a prototype of the AO for European Solar Telescope (EST). EST is a 4.2-m telescope that will provide high resolution in a 60" circular Field of View (FoV). For this purpose, EST will be equipped with an MCAO system that will be integrated into the telescope's optical path. The aim of the testbed is to analyse different sensing and wavefront correction strategies in order to check their suitability for EST. The testbed is a downscaled version of the telescope that has been designed to replicate its main features, including the telescope aperture, the FoV and the atmospheric conditions representatives of the telescope site. It allows to set up of Single Conjugate Adaptive Optics (SCAO), Ground Layer Adaptive Optics (GLAO) and MCAO configurations, both for point-like and extended sources. For this purpose, three Shack-Hartmann Wavefront Sensors (WFSs) have been developed and installed in the testbed. A High-Order Wavefront Sensor (HO-WFS) with 33x33 sub-apertures senses on-axis 10" FoV. Additionally, a Multi-Directional WFS (MD-WFS) estimate the turbulence over the entire atmospheric volume. It allows up to two possible configurations: one high-order spatial resolution (HO-MD-WFS); and another low-order spatial resolution (LO-MD-WFS). A pupil-conjugated Deformable Mirror (DM) with 820 actuators is currently available for SCAO and GLAO configurations. The introduction of two DMs conjugated to different altitudes will allow the correction of the wide field with high resolution in the presence of upper atmospheric layers.

The main aim of this contribution is to present the results obtained for SCAO and GLAO configurations in the EST testbed under different turbulence conditions. A Centre of Gravity (CoG) algorithm was used to compute the sensor slopes when a point-like source was analysed. Different correlation algorithms were also evaluated when extended sources were studied. An image of solar granulation was used to that end.

Keywords: testbed, SCAO, GLAO, wavefront sensing, extended field, solar, EST, MCAO

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