
The HARMONI SCAO system: wavefront control and basis optimisation

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Abstract

HARMONI is the first light visible and near-IR integral field spectrograph for the Extremely Large Telescope (ELT). It covers a large spectral range from 450nm to 2450nm with resolving powers from 3500 to 18000 and spatial sampling from 60mas to 4mas. To achieve diffraction limited performance HARMONI can operate in two Adaptive Optics (AO) modes: Single Conjugate AO (SCAO) and Laser Tomographic AO (LTAO). The HARMONI SCAO system is based on a pyramid wavefront sensor (PyWFS) operating in the visible (700 – 1000 nm). Here we will present an overview of the AO system and control scheme, reporting on end-to-end simulations and demonstrating the performance of the HARMONI SCAO system across a range of atmospheric conditions. We consider the impact of optical gain, PyWFS misregistrations and badly seen ‘petal modes’ on the performance. We will present on recent efforts to incorporate the force budget of the ELT’s deformable mirror (M4) into our simulations and demonstrate how knowledge of the stress response of M4 can be used when building the SCAO control basis to avoid saturation events and optimise performance. Finally, we will combine these functionalities to present a simulated acquisition sequence and analyse its robustness.

Keywords: Pyramid WFS, SCAO, KL modes, Force, ELT, HARMONI

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