Non-modulated pyramid wavefront sensor for ELT SCAO systems

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Abstract

In the context of the single conjugate adaptive optics (SCAO) systems for the next generation of telescopes the pyramid wavefront sensor (PWFS) is the preferred solution. This kind of sensor will measure the continuous turbulence and the differential piston with the goal of compensating both and producing a well-corrected wavefront to the scientific instruments. In this work we study the possibility of disabling the pyramid modulation to maximize the sensitivity of the sensor. This configuration is particularly appealing for differential piston sensing, but it was historically discarded due to the reduced robustness in presence of residual turbulence. So we increased the loop stability in this configuration by setting a more accurate calibration of the non-modulated PWFS response in partial correction. We describe this new calibration approach and we show by the means of numerical simulations the sensitivity and performance of a SCAO system for the extremely large telescope with disabled modulation and we compare it with a case configured with a PWFS with a typical modulation radius of a few lambda/D.

Keywords: simulation, single conjugate adaptive optics, pyramid, ELT, calibration

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