

Seeking for the ultimate wavefront sensor - Probing the free-parameters space of Fourier-based wavefront sensors with the LOOPS v2.0 testbed.

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Linearity, sensitivity and dynamic are the trinity of adaptive optics (AO). A wavefront sensor excelling in both these three domains is the Holy Grail for AO scientists. The first integrations of Fourier-based wavefront sensors (F-WFS, like Zernike, Pyramid, etc.) in AO systems show that these devices are capable of high performances and are therefore establishing themselves as the new standard. They are as well very modular objects that can be tuned to improve their functioning regime regarding linearity, sensitivity and dynamic. In order to develop our knowledge, deliver the best performances from AO systems and propose new insights on F-WFS, we developed the versatile AO testbed called LOOPS. On this bench we can now control: (1) the phase of the Fourier filtering mask in the focal plane, allowing to produce any flavor of WFS (3-faced, 4-faced, n-faced pyramids / Ingot / axicone / Zernike / iQuad etc.) (2) the turbulence in the pupil plane, allowing to reproduce several observing conditions (r_0 , wind speed, power spectral density) (3) the tip-tilt modulation in the pupil plane, allowing to modulate the PWFS in the classical way or produce arbitrary shaped objects like elongated LGS spots Using data obtained from the bench, we present a complete and clear static comparison of different F-WFS in terms of linearity, sensitivity and dynamic. In a second time, we show the performances of the chosen F-WFS in closed-loop operation in terms of bootstrap and residuals RMS capacities.

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