
Non-Common Path Aberrations Strategy for the METIS High Contrast Imaging Modes

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Abstract

Non-common path aberrations (NCPAs) are widely recognized as one of the main limitations of current and future high-contrast imaging instruments. The slow variation of NCPAs generates quasi-static speckles (QSS) that are coherently modulated by the AO speckles. This increases speckle noise and reduces the achievable contrast, thus leading to a significant hit in HCI performance.

In METIS, NCPAs – due to optical imperfections – are minimized by design, and the gravity-invariant design should keep their time variation to a low level. Yet the short- and long-term variations of the NCPA, driven e.g. by chromatic beam wander, can lead to a significant hit in HCI performance and need to be measured and corrected. But the METIS high contrast imaging modes face another challenge, especially at longer wavelengths, posed by water vapor turbulence. Because it is highly chromatic and changes dynamically, it sets new requirements on our NCPA algorithms: the ability to infer the phase aberration quickly at a 100% duty cycle.

In this contribution, we present our latest developments and discuss how our strategy has been adapted to better tackle this challenge. In particular, we will detail the various algorithms we have been investigating : QACITS for tip-tilt sensing in the case of the vortex coronagraph, Phase Sorting Interferometry (PSI) for higher-order (quasi-)static aberrations, and finally focal plane wavefront sensing with an asymmetric Lyot mask to measure dynamically changing higher-order aberrations.

Keywords: focal plane wavefront sensing, METIS, coronagraphy, vortex, simulations

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