Sequential coronagraphic focal-plane wavefront sensing and control

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Abstract

Coronagraphs are sensitive to low-order aberrations, with performance rapidly degrading with small amounts of wavefront error. Low-order aberration control (including pointing control) at the coronagraphic focal plane is key to attaining optimal performance. Several algorithms have been developed that can control such aberrations, though they require phase diversity techniques (meaning reduced science uptime) or are developed for particular coronagraphic architectures. We present two new methods, an analytical and machine-learning approach, that are based on sequential phase diversity techniques. The analytical method works with all optical systems with even symmetry, and the machine-learning approach works without any symmetry assumptions. Both algorithms do not require dedicated diversity frames, meaning high science uptime. We present simulation and preliminary benchtop implementation.

Keywords: wavefront sensing, focal plane wavefront sensing, phase diversity, psf sharpening, psf reconstruction

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