Pyramid wavefront sensing developments at NRC-HAA

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Abstract

Many next generation adaptive optics (AO) systems, on both 10-m class telescopes and future giant segmented telescopes, plan to incorporate a pyramid wavefront sensor (PWFS) to achieve their performance requirements. As a non-linear wavefront sensor (WFS), different strategies have been proposed to ensure the optimal operation of the PWFS on-sky including various non-linear reconstructors and optical gain calibration/tracking algorithms. Since many of the instruments being developed at NRC-Herzberg contain a PWFS, we are re-establishing a PWFS testbed. We present the design for the AO WFS bench and first light results of the PWFS arm of the bench. Using this new testbed in the AO laboratory, we will explore optical gain calibration using the gain scheduling camera (V. Chambouleyron et al, 2021) as well as more exotic ideas to improve the PWFS such as time-resolved wavefront sensing (J. Véran et al 2022). We also present details about the synchronization of the modulation mirror and camera for high-speed operations while supporting dithering. A key design of the bench is the portability of the PWFS arm such that it can be ported to NRC-Herzberg's on-sky AO system, REVOLT, for on-sky testing of the PWFS with the HEART real-time-controller being developed locally. We will present results towards operating the PWFS on REVOLT.

Keywords: Pyramid wavefront sensing, testbed, R&D

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