Laboratory Demonstration of a Correlation-Based Adaptive-Optical System for Wavefront Sensing of Extended Objects

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Over the last few decades, adaptive-optical (AO) techniques have been developed to mitigate the deleterious effects of atmospheric turbulence on imaging systems. Traditionally, AO systems have relied on a point source beacon, either a natural star or a generated laser guide star, to provide a reference for the wavefront sensor (WFS). However, for passive, remote imaging applications, such a reference source is not generally available and the extended nature of the object can severely degrade the performance of conventional Hartmann WFSs using quad-cell or other centroid estimation approaches. Correlation wavefront sensing has been proposed as a means of improving AO performance in these applications. Correlation methods are more accurate and robust and less sensitive to noise than centrioding algorithms. Over the last year, researchers at the Starfire Optical Range (SOR), Optics Division, Air Force Research Laboratory, have been developing a correlation WFS for remote imaging of extended objects. The design of a prototype sensor is described and results from a laboratory demonstration performed in the SOR's ASALT Laboratory are presented.