Improved Differential Shack-Hartmann Wavefront Curvature Sensor

Experimental System For The Differential Shack-Hartmann Curvature Sensor According To The First Embodiment Of The Present Invention

The design of a differential Shack-Hartmann wavefront sensor made of a twice split input wavefront, into the x-, y- and z-axis, that are each sampled by a lenslet array and compared to determine the wavefront’s local curvature.

In any optical system, aberrations are present in the light’s wavefront. These aberrations are deviations from a perfect spherical wavefront. These errors come about due to the geometry of optical elements, their arrangement in a system and any other interference seen along the optical path. Because the wavefront is an optical phase phenomenon (surfaces of constant phase) it is difficult to detect. Adaptive optic technologies aim to compensate and correct for these aberrations by deforming optical elements in response to the known imperfections, but establishing this knowledge is not a simple task.

Technical Details

There are a few methods for sensing these wavefront characteristics, one being the Shack Hartmann sensor. By sampling a cross-section of the light with an array of lenses onto a corresponding array of detectors, one may reconstruct the wavefront based on the error of each section of the cross-section. This sensor is, however, sensitive to vibrations and requires an external reference light source. Researchers at UCF have developed a differential version of this wavefront sensor that eliminates the need for external reference and, therefore, eliminates sensitivity to environmental disturbance.

Benefits

• Eliminates the need for an external reference light source
• Not sensitive to vibration or whole-body movements

Applications

• Shack-Hartmann style devices
• Adaptive optics
• Optical element testing
• Ophthalmology
• Atmospheric and random media characterizations

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Inventors

Jannick Rolland, Ph.D. • Weiyao Zou

For more information, contact:

John Miner | 407.882.0342 | john.miner@ucf.edu | Tech ID #30559
UCF Office of Technology Transfer | 12201 Research Parkway, Suite 501, Orlando, FL 32826