A Novel Wavefront Sensor for Solar Adaptive Optics Based on Integrated Photonics

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Abstract

In this work, a novel kind of wavefront sensor (WFS) for adaptive optics in solar physics based on integrated photonics is proposed. Shack-Hartmann and plenoptic sensors are limited to pupil sampling of approximately 8 cm because they need a solar granulation image with a minimum contrast to be able to compute displacements. To overcome this limitation and effectively use existing deformable mirrors with thousands of actuators, a novel wavefront sensor is proposed, which will be able to obtain wavefront phase differences of the beam with higher pupil sampling. The proposed wavefront sensor can increase the resolution and the speed with respect to the other sensors as the incoming wavefront is obtained by passing the wavefront through optical fibres to the integrated photonics wavefront sensor (IP-WFS) and directly measuring the phase differences without the generation of images. In the same way as Shack-Hartmann and plenoptic sensors, the proposed IP-WFS delivers data about the phase differences on the incoming wavefront to subsequently use this information to calculate the deformable mirror actuation. Consequently, the integration of the proposed IP-WFS in the current systems of adaptive optics can be performed without having to make drastic modifications to the existing instruments.

Keywords: Solar physics, Adaptive Optics (AO), Photonic Integrated Circuit (PIC), Integrated Photonics Wavefront Sensor (IP WFS)

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