Linearizing the unmodulated pyramid wavefront sensor

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Abstract

The Pyramid Wavefront Sensor (PyWFS) has gained considerable attention in the field of adaptive optics due to its high sensitivity and low wavefront noise. However, the PyWFS exhibits some non-linearities. To address this issue and increase the linearity range of the PyWFS, a modulation is typically applied, but this comes at the cost of decreased sensor sensitivity. In context of the VLT/RISTRETTO instrument, a high-resolution spectrograph that will be fed by an extreme adaptive system, a high sensitivity to low order wavefront aberrations will be particularly required to achieve its driving science goal of characterising the atmosphere of the rocky exoplanet Proxima b. Therefore using an unmodulated PyWFS would have significant performance gain. Hence, we are conducting a study to investigate the behaviour of the unmodulated PyWFS, with the goal to linearise the response of the sensor, with a particular focus on finding a phase basis that increases the linearity range of the sensor. The results of this study would also provide insights for the future ELT instruments, where an unmdolutated PyWFS could be used to detect small phase discontinuities across the ELT's spiders and segmented primary mirror.

Keywords: Unmodulated Pyramid Wavefront Sensor, RISTRETTO, High Contrast High Resolution Spectroscopy, Exoplanet Characterisation

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