PAPYRUS : Overview of the AO On-sky performance

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Abstract

PAPYRUS is a pyramid-based adaptive optics system installed at Observatoire de Haute Provence (OHP), on the T152 (1m52 diameter telescope). Its main purpose is the development and the experimentation of innovating ideas gravitating around AO and imaging for astronomy. The ongoing evolution of the bench is to promote it at the rank of scientific instrument. Combining PAPYRUS with the IR fiber spectrograph VIPA (developed by IPAG) will allow for instance the observation of binary stars and brown dwarfs, with contrast ratios similar to that between a star and a planet. The installation of an IR camera and coronagraph will allow the observation of protoplanetary disks and some exoplanets (e.g. HR8799, already observed at PALOMAR reduced at 1.5 m diameter).

Before the installation of such a device it is important to well characterize the performances of the system. This preliminary work is necessary to develop the instrumental part. Thus we present in this work the nominal performance of the system as measured on-sky. Firstly, the bench is used in its simplest configuration: a visible pyramid-WFS controlling a 17x17 deformable mirror in closed loop running at 1500 Hz. The performance is estimated in terms of Strehl Ratio at visible and Infrared wavelength. In a second step, we explore the performances of the AO system optimized with an optical gains tracking method.

The measurement of the optical gains in real-time is made possible with the integration of a gain sensing camera (GSC) and a convolutional-based analytical model. The GSC is localized in a focal plane conjugated with the tip of the Pyramid to capture a snapshot of the PSF shape that can be directly linked to the effective optical gains. Compensating the optical gains allows to enhance the performance of the system. Moreover, it will be a precious help in the future to increase the contrast ratio of the high-contrast arm by using dark-hole technique and NCPA compensation.

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