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# PAPYRUS : The new ALPAO RTC features

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## Abstract

PAPYRUS is a pyramid-based adaptive optics system installed on the 1.52m telescope of Observatoire de Haute Provence (OHP, France).

Adaptive optics real time applications (Astronomy and FSO) require RTCs with increasing performance on ever larger problem sizes. This performance is often achieved at the cost of increasingly complex, more expensive, and less flexible clusters.

ALPAO has developed its own RTC solution that runs on standard servers with a MATLAB layer (Alpao Core Engine software) as user interface. This solution allows greater ease of use and flexibility. Indeed, all the calculations that do not need to be done in real time are done in the MATLAB layer, such as calibrations and parameterization of the AO loop.

ALPAO RTC can be easily adapted to various AO configurations. In addition to standard SISO (Single Input Single Output) configurations, the MIMO (Multiple Input Multiple Output) configuration is now supported. Various interfaces are available, such as camera link connections for wavefront sensors (WFS), 16-bit parallel connections for ALPAO DMs and 10 GigE Vision connections for DMs and WFSs.

Thanks to the collaboration between ALPAO and LAM in the framework of the ALAMO project, the ALPAO RTC is now capable of closing the loop on-sky with the Pyramid wavefront sensor (PyWFS), in both slopes map and intensity map modes. Measurements with the PAPYRUS bench at OHP with a loop rate of 1.5kfps, a detector size of 240x240, a calculation area of 160x160 and an ALPAO DM241, yields an RTC latency of 130 $\mu$ s. A new ALPAO Shack Hartman WFS has been integrated into the PAPYRUS bench, with the same RTC as for the PyWFS at a loop speed of 900Hz, a 10 GigE Vision detector with a size of 512x512 and 32x32 micro lens array, yields an RTC latency of 29 $\mu$ s.

**Keywords:** Adaptive Optics (AO), Real Time Computing (RTC), System, Shack Hartmann Wave Front Sensor (SHWFS), Pyramidal Wave Front Sensor (PyWFS), Deformable Mirror (DM), On sky, PAPYRUS, OHP, Alpao Core Engine (ACE)

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