

Pseudo-Synthetic Interaction Matrix with Pyramid WFS: focusing on the mis-registrations identification.

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Summary

Future Extremely Large Telescopes (ELT) will include large Deformable Mirrors (DM) directly located inside the telescope. This characteristic will be constraining for the AO calibration as the registration between the DM and the wavefront sensors (WFS) may evolve during the operations. These so-called mis-registrations highly affect the performance of the AO system and have to be monitored and compensated, for instance by updating the interaction matrix of the system. In the case of the future ELT, considering the large number of actuators, re-acquiring a whole interaction matrix will be problematic in terms of telescope operations (especially with no artificial calibration source). It becomes then necessary to optimize the AO calibration procedures.

At the VLT-Adaptive Optics Facility (AOF) working with a Shack-Hartmann WFS, the strategy consists of developing synthetic models of the AO systems to generate noise-free interaction matrices, injecting mis-registrations parameters identified from telemetry data. This Pseudo Synthetic approach relies on two key-ingredients: the ability to model accurately the WFS and DM and the accuracy of the mis-registrations parameters.

Considering that the future instruments of the ESO-ELT will all include a Pyramid WFS (PWFS) for their SCAO mode, there is a need to investigate the feasibility of such a strategy working with PWFS. In this communication, we will present the experimental validation of such a pseudo synthetic model for the AO systems of the Large Binocular Telescope. We will then focus on our current activities and preliminary results to optimize/develop mis-registrations tracking methods with PWFS, eventually using the ESO High Order Test-bench (HOT).

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