Recent developments of adaptive optics at ALPAO

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Purpose

The aim of this talk is to present the developments in adaptive optics achieved by ALPAO. It will be shown how the pace of development of instruments can be increased using the ALPAO Core Engine. Furthermore, the key performances of our latest deformable mirrors will be presented. Both developments aim to reduce the complexity of adaptive optics systems.

Methods

The main obstacle to adaptive optics for many applications is its complexity (real or perceived). Adaptive optics is complex since it combines a number of different engineering skills: optics, mechanics, analog and digital electronics, and computer sciences. Numbers also speak by themselves: an adaptive optics system is, at the same time, a metrology system accurate to a few tens of nanometers, a servo loop with hundreds of inputs /outputs, and an electromechanical system controlled at hundred of hertz. The perceived complexity must be reduced.

ALPAO has developed an open and modular architecture for Matlab. This toolbox called *ALPAO Core Engine* allows using either built-in closed-loop routines or developing user-specific ones without losing performances. The typical frame rates achievable are more than an hundred Hertz with COTS off-the-shelf adaptive optics parts. Of course, it is possible to build a graphical user interfaces (and still having the possibility to automate tasks with scripts).

Furthermore, most of the applications of adaptive optics suffer from imperfections of deformable mirrors. We will present our latest developments towards a *perfect* open-loop deformable mirror. We will highlight the benefits for standard adaptive optics systems using wavefront sensors but also for systems working without wavefront sensors. Examples showing how to implement those strategies within ACE will be demonstrated.

Conclusions

Two ways to reduce the complexity of adaptive optics have been introduced either by simplifying the control architecture or by simplifying the optical set-up. The authors believe that it will make easier the use of adaptive optics for industry and medicine.