Title: Performance of spatial filtering wavefront sensor for the phasing of segmented telescopes

Abstract: The next generation of extremely large telescopes requires the use of segmented mirrors. This technology needs specific wave front sensors to measure the alignment and phasing state. This paper compares three specific technologies for the measurement of phase steps between segments: a simple pin hole, a Mach-Zehnder interferometer and a phase contrast sensor. The efficiency of each sensor will be quantified by calculating the Fisher information, first, under ideal conditions, then including the effects of sampling, misalignment, atmospheric turbulence and source elongation.

Technical abstract:

The next generation of extremely large telescopes requires the use of segmented mirrors. This technology needs specific wave front sensors to measure the alignment and phasing state. This paper compares three specific technologies for the measurement of phase steps between segments: a simple pin hole, a Mach-Zehnder interferometer and a phase contrast sensor.

The reason for the choice of these three sensor are the following. The mach-zehnder was already considered on a test bench called APE and will constitute our reference because it is well documented. The phase contrast sensor was the final version of the mach-zehnder and has reported excellent robustness to misalignment. The pin hole is a test to understand if the phase contrast technology represent a real advantage or if a simpler sensor would be as efficient. All three present the advantage that pupil registration is made computer wise.

The efficiency of each sensor will be quantified by calculating the Fisher information, first, under ideal conditions, then including the effects of sampling, misalignment, atmospheric turbulence and source elongation. The ideal condition have already been studied for all three sensor. It shows that the phase contrast sensor and the mach-zehnder interferometer are more sensitive to small piston step than the pin hole.