

Wavefront Control for High Contrast Imaging

Direct imaging is the best solution to study long orbital period exoplanets but it is challenging. The hosting star is 10^4 to 10^{10} times brighter than its planet that stands at less than 1 arcsec. Coronagraphs have been proposed to suppress the stellar light without reducing the planetary flux. However, their performance is limited by wavefront aberrations that induce stellar speckles mimicking planet images in the science image. Adaptive optics compensate for most of the atmosphere turbulence in ground telescope instruments but quasi-static aberrations always remain (flexure with pointing, optical aberrations of moving optics, etc). In space, quasi-static aberrations also exist (thermal expansion). Dedicated techniques are thus needed to control the wavefront with sub-nanometer sensitivity. All these techniques modulate the speckle intensity to retrieve the associated electric field complex amplitude and then, the wavefront aberrations that are corrected using a deformable mirror. Most of the techniques use time modulation. Others use spatial modulation. I will present the principle of the different techniques and I will show laboratory results obtained by different teams.