

The problem of atmospheric tomography in complex Adaptive Optics systems

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Abstract: Adaptive Optics (AO) systems in large ground-based telescopes aim at mechanically correcting for atmospheric distortions by means of deformable mirrors. Light from several astronomical objects or artificially created laser beacons is measured in order to determine the optimal shape of the deformable mirrors. This problem is referred to as atmospheric tomography and is an ill-posed inverse problem. For the new generation of Extremely Large Telescopes (ELT) with mirror diameters of more than 30 m, complex AO systems with frame rates of around 500 Hertz, i.e. a reconstruction time of 1 ms, demand fast algorithms. We present a variant of the gradient method for the solution of this limited-angle tomography problem. Real-life effects such as tip/tilt indetermination, cone effect and spot elongation are included in the modelling. Simulation results are presented within a 42 m ELT-setting on OCTOPUS, the end-to-end simulation tool of the European Southern Observatory.