

Tomography for Image Improvement of Large Astronomical Telescopes

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The image quality of ground based astronomical telescopes suffers from turbulences in the atmosphere. A significant image improvement can be achieved by the use of Adaptive Optics (AO) systems. An AO system consists of (several) wavefront sensor that measure the incoming wavefronts from incoming bright guide stars, a real time computing unit and (several) deformable mirrors. Based on the measurements of the incoming wavefronts, the problem is to compute the shape of the deformable mirrors such that in the reflected image the influence of the turbulent atmosphere is removed. The main mathematical problem in the reconstruction process is Atmospheric Tomography, i.e, the determination of the turbulent atmosphere above the telescopes from the incoming wavefronts. As the atmosphere changes rapidly, its reconstruction has to be done in real time. In the talk, we give an introduction into the mathematics of Adaptive Optics and present fast algorithms for Atmospheric Tomography as well as for the computation of the optimal shape for the correcting deformable mirrors. Finally, we will give some numerical examples for the European Extremely Large Telescope (E-ELT), wich is currently under construction by the European Southern Observatory (ESO).