
Finally, let's use all the modes!

Andreas Obereder^{*†}, Markus Feldt , Carlos Correia , Horst Steuer , and Thomas Bertram

¹MathConsult GMBH (MathConsult) – Altenbergerstraße 69 A - 4040 Linz, Austria

Abstract

Subtitle: A stable DM fitting avoiding modal truncation

For the AO Control of the ELT instrument METIS a two-step method has been developed. First, we reconstruct the incoming wavefront from modulated Pyramid WFS measurements, second, we project this wavefront estimation on a set of modes defined on the M4 of the ELT. Here we focus on the second step, the stable fitting step of a wavefront on modes.

In very bad seeing conditions or for faint guide stars previous methods have utilized modal truncation. In order to stay stable, the number of modes was reduced, i.e., less spatial frequencies were used. If simply truncating modes one is not able to explicitly control spatial frequencies, the effects of the truncation are visible in the modal representation of the wavefront, the overall quality of the AO system decays.

To avoid these effects of truncation and to adapt the fitting step to the statistics of either full atmospheric screens or residual screens we introduce a regularized fitting step using all available modes based on the same statistical information as the wavefront reconstructor. We will present the properties of this fitting steps as well as improved closed loop simulation results for the instrument METIS. We will show that with very few reconstructor parameters, even with a constant set of parameters for the control, we obtain a stable and good performance of the AO system over all seeing and flux conditions studied.

Keywords: wavefront projection, DM control, modal control

^{*}Speaker

[†]Corresponding author: andreas.obereder@mathconsult.co.at