
Optimal modal basis for ELT M4 mirror Force/Position control

Carlos Correia^{*†1}, Christophe Verinaud[‡], Cedric Taissir Heritier[§], Horst Steuer[¶],
Markus Feldt^{||}, and Thomas Bertram^{**}

¹Space ODT - Optical Deblurring Technologies Ltd – Portugal

Abstract

Context. The deployment of large scale adaptive deformable mirrors on 10m-class telescopes is now well established. Furthermore, such mirrors have been adopted by two out of the three Giant Segmented Mirror Telescopes now under design. In all these cases, the proprietary technology is based on voice-coils and is limited in force, stroke and velocity.

Aims. Our goal is to generate Karhunen-Loève (KL) bases for optimal wavefront control. Our basis integrate force limitations in their definitions whilst maintaining standard orthonormality, statistical independence and are expressed fully within the deformable mirror spanned space.

Methods. We use the so-called double diagonalisation method whereby the principal components of a stochastic process (the turbulence) are expressed as linear combinations of the principal components of the deformable mirror (mechanical modes). The basis so obtained is ranked by the force applied on the actuators.

Results. The analysis of this new KL basis for von Kármán turbulence statistics is made and the Fitting error, Positions and Forces distribution are presented. We further illustrate their use in the case of the early adopter instrument METIS – the Mid-Infrared ELT Imager and Spectrograph – to be installed on the Extremely Large Telescope (ELT), using transient analysis (time-domain) covering the handover period, from telescope to the instruments. Other non-stationary events, such as the recurrent optimisation of the mirror units is also covered.

Keywords: Modal basis, optimal AO reconstruction and control

*Speaker

†Corresponding author: carlos.correia@fe.up.pt

‡Corresponding author: cverinau@eso.org

§Corresponding author: Cedric.Heritier@eso.org

¶Corresponding author: steuer@mpia.de

||Corresponding author: mfeldt@mpia.de

**Corresponding author: bertram@mpia.de