

Refined Adaptive Optics simulation with wide field of view for the ELT.

M. Chebbo(1), T. Fusco(2), J.-F. Sauvage(2), J.-M. Conan(2), S. Meimon(2), B, Le Roux(1)

Mail: manal.chebbo@oamp.fr

(1) Observatoire de Marseille – LAM

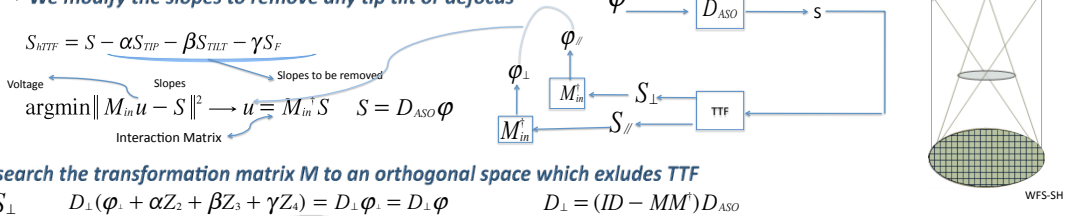
(2) Office National des Études et de Recherches Aérospatiales, DOTA/HRA, Châtillon, France

Abstract: A new E2E simulator is developed. It is based on an iterative resolution of all the linear relations (such a voltage to slopes, slopes to phase, etc) with high number of degrees of freedom (using the sparse matrix) and includes new concepts of filtering and coupling between LGS and NGS to effectively manage modes such as tip / tilt and defocus in the entire process of tomographic reconstruction.

Tip, Tilt and Defocus Indetermination

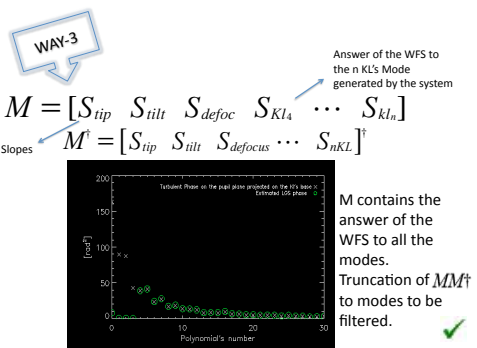
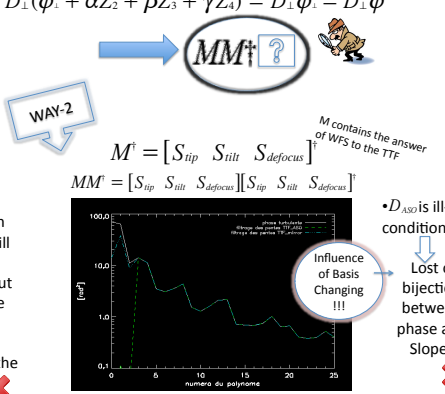
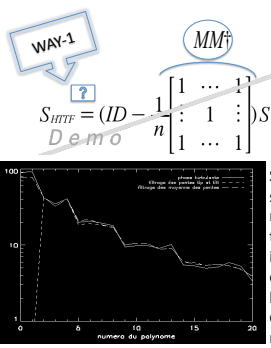
- TTF are affected by the position of the LGS in the sodium level.
- The fluctuation of the sodium layer's makes us lose information about the exact LGS altitude.

Goal: Generate realistic WFS measurement's with filtered out TTF
 ✓ We modify the slopes to remove any tip tilt or defocus



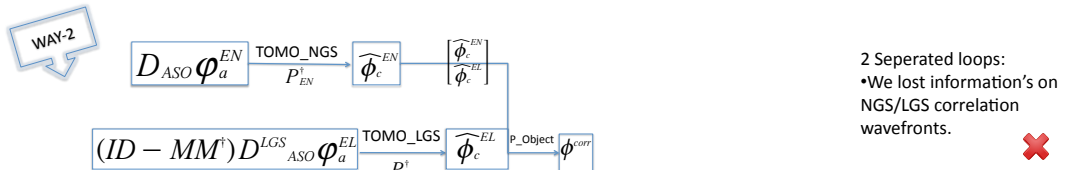
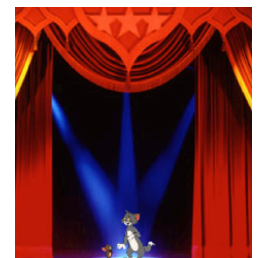
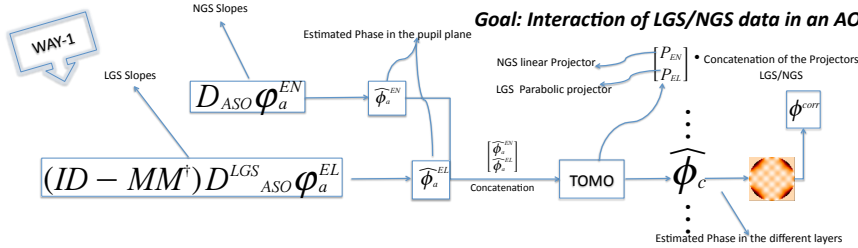
✓ We search the transformation matrix M to an orthogonal space which excludes TTF

$$S = S_{//} + S_{\perp} \quad D_{\perp}(\phi_i + \alpha Z_2 + \beta Z_3 + \gamma Z_4) = D_{\perp}\phi_i = D_{\perp}\phi \quad D_{\perp} = (ID - MM^T)D_{ASO}$$



Fusion Data LGS/NGS

Goal: Interaction of LGS/NGS data in an AO system

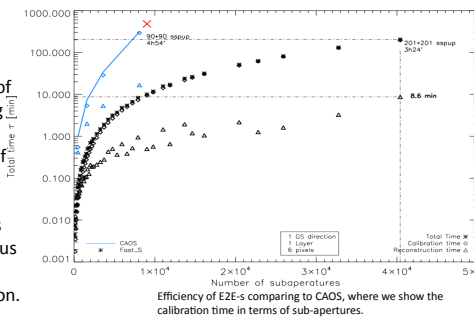


E2E-S

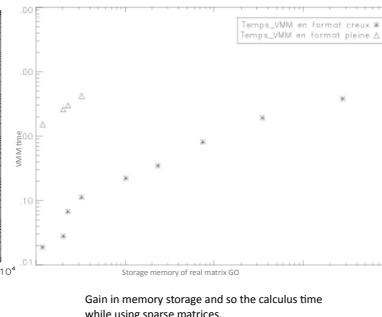
High Degree's of Freedom

New E2E simulator:

- Based on an iterative resolution of the linear model with high number of degrees of freedom (using the sparse matrix)
- Includes new concepts of filtering and coupling between LGS and NGS to effectively manage modes such as tip / tilt and defocus in the entire process of tomographic reconstruction.

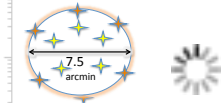


Typical Results



EAGLE LIKE Simulation's

- ✓ 9 Layers
- ✓ 83*83 Sub-aperture
- ✓ 6 LGS on 7.4 arcmin
- ✓ 5 NGS inside the 7.5 arcmin
- ✓ @589 nm



Conclusion & Perspective

- ✓ A new E2E-S simulator using the sparse matrix.
- ✓ Optimal way for TTF indetermination.
- ✓ Materials for Fusion data LGS/NGS

- Simulation EAGLE in progress.
- Merging Data LGS/NGS in the near future.
- Article & PHD dissertation

References:

- Methods for correcting tilt anisoplanatism in laser-guide-star-based multiconjugate adaptive optics Brent I. Ellerbroek and Francois Rigaut.
- Split atmospheric tomography using laser and natural guide stars. Luuc Gilles and Brent I. Ellerbroek