Integration of optical data and FE model to drive wavefront correctors in AO systems

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Activities foreseen in the framework of the minigrant:

WorkPackage 1:

I will develop a numerical code to simulate interferometric measurements of a DM. The simulator will be used to identify the measurement procedure of the displacement sensors gain. In particular, it shall be free from geometrical constraints and not limited to full-aperture measurements and adaptable to stitching. The last point will be the identification of the key-parameters for the fine tuning of the FE model to allow a high-performance synthetic calibration of the auxiliary loops.
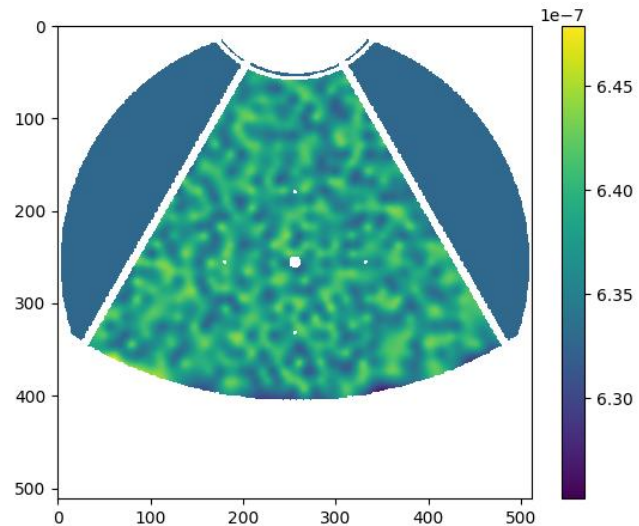
WorkPackage 2:

I will identify a laboratory setup to test the procedure on a DM in a laboratory environment. I will calibrate the actuators response and in the end the FE model.
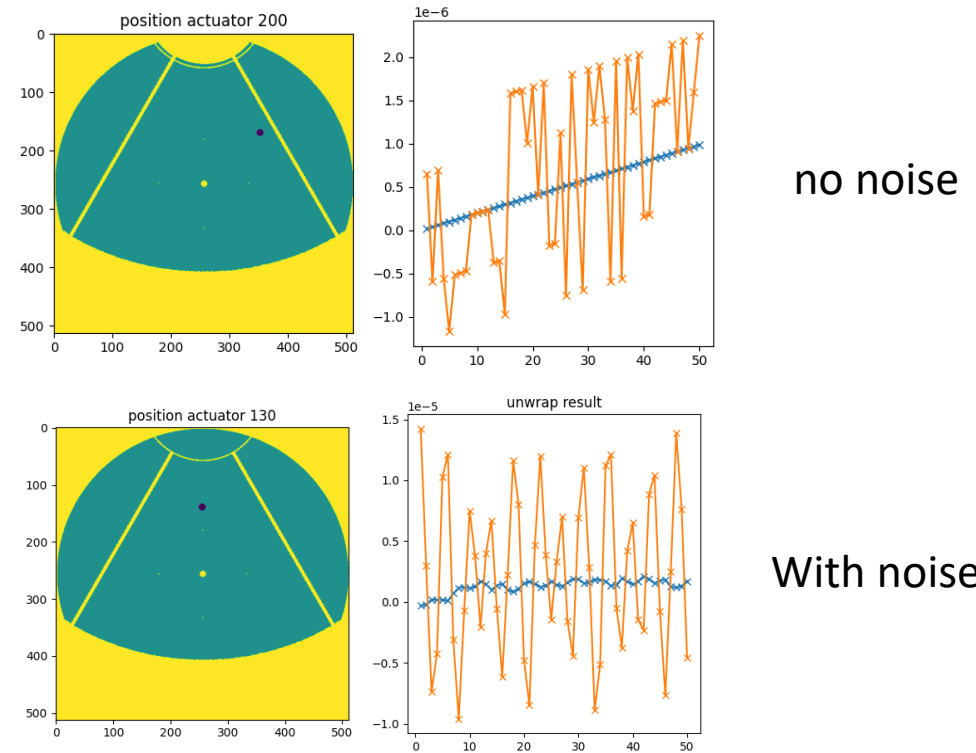
1) Developement of a software to simulate a deformable mirror (DM) and to simulate real interferometric measurements

Simulation of the capsens calibration for a single actuator, with and without noise

Simulation of the interferogram of a section of M4 for ELT. Random positions are applyed to the actuators
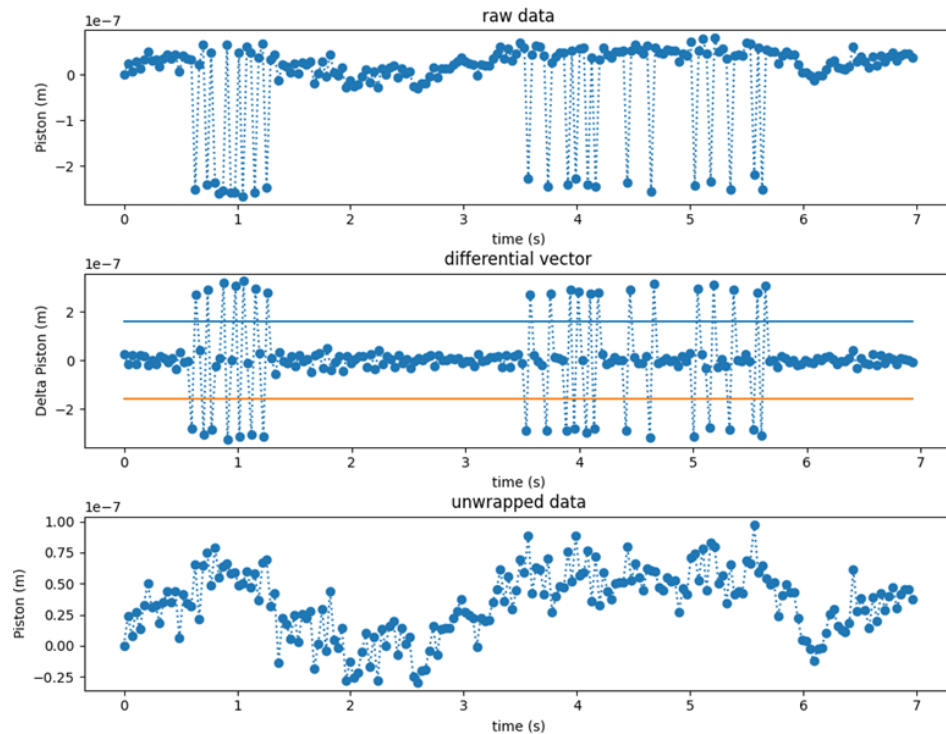

no noise

With noise

WorkPackage 1: activities done

2) Analysis of real measurements acquired on the Optical Tower of M4, in order to evaluate the noise and test the algorithms

Row data passing through the unwrapping algorithm, needed to avoid the intrinsic interferometric phase uncertainty

Application af the Differential algorithm used to lower the noise level in the measurements

$$D(j, M, v) = \frac{1}{(M-1)} \sum_{i=1}^{M-1} (\Phi_i(j, v) - \Phi_{i-1}(j, v)) (-1)^i 2^{-1}$$
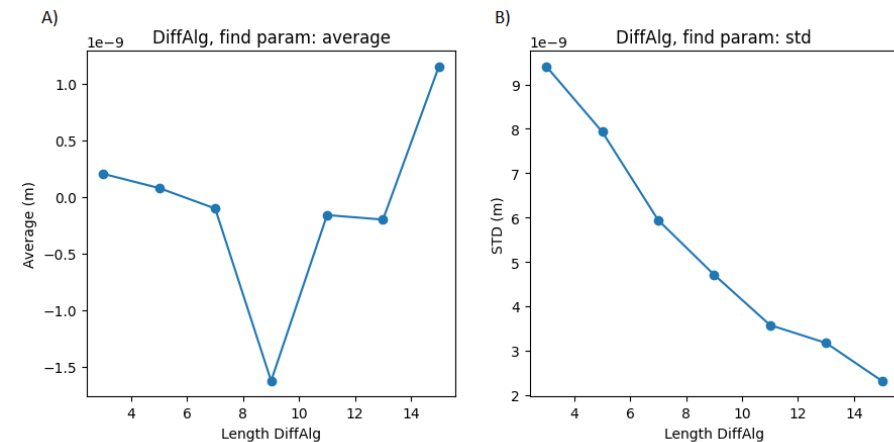
WorkPackage 2: activities done

1) Some test measurements have been performed on a laboratory setup at the Astronomical Observatory of Arcetri. The setup is based on an ALPAO DM measured with a 4D interferometer.
   The experiment is currently undergoing
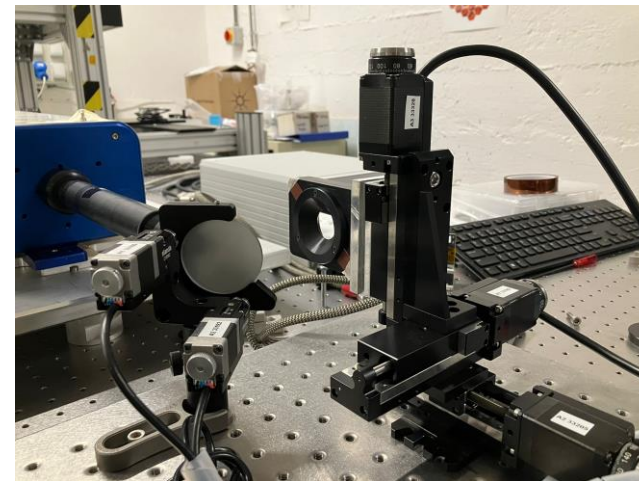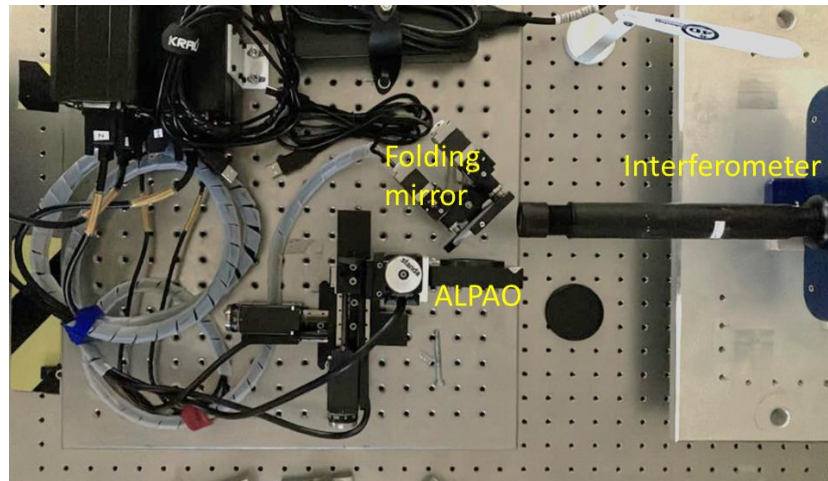
Milestones

M1. Simulations completed (D1, D2, D3): The simulator has been completed and all the simulations have been performed. ON GOING

M2. Calibration procedure defined (D3, D4): The calibration procedure has been decided and simulated, ready for the laboratory tests. ON GOING

M3. Laboratory activities completed (D3, D4): All the tests have been performed and the calibration procedure has been updated accordingly ON GOING

M4. Project completed

Budget

Foreseen budget

Item	Yr 1	Yr 2
Simulation workstation	5000 €	
Missions to Firenze	1000 €	1000 €
Missions to ADS, microgate		2000 €
Laboratory equipment	4000 €	2000 €
Conferences and fees		3000 €
Publications fees		2000 €

- 2 missions to Firenze have been done
- The work station acquisition is on-going
- No laboratory equipment have been procured jet