FACVC Project Proposal

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The problem is a simplification of the biggest problem in Adaptive Optics. This term comes from technology used in optical systems to recover angular resolution, often called image quality. Which is lost when the observations are made through turbulent mediums.

The solution to it lies in estimating the optical wave-fronts from measurements and the applying its inverse to a collection of sophisticated deformable mirrors in real time.

In this project, I aim to tackle only a simplification of the problem. Which consists of a telescope with only four mirrors spaced in accordance with Fig. 1. The data necessary is going to be simulated using the algorithm below:

1. Randomize the position of each of the mirrors (piston, tip and tilt);
2. Calculate the phase map for each of the mirrors;
3. Compose the matrix of the telescope with the phases of the 4 mirrors;
4. Calculate the electric field in each point of the telescope 1 where ϕ is the phase at the point and A is a constant;
5. Calculate the measurement of the telescope's sensor using 2, where $\hat{E}$ corresponds to a fourier transform of E.

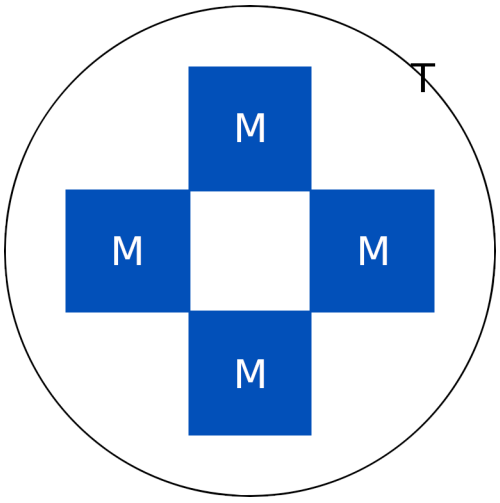

Figure 1: Diagram of the telescope: (M): deformable mirrors, (T): telescope lens

$$E = Ae^{(\imath\phi)} \tag{1}$$

$$s = |\hat{E}|^2 \tag{2}$$

After the data is generated, I aim to tackle the regressions problem of determining the original position of the mirrors from the estimated sensor measurements. For this I will explore deep learning algorithms such as Convolutional Neural Networks and try to do some feature extraction to apply more traditional methods such as Support Vector Machines.