

PROPOSAL FOR AN INTERNSHIP

Laboratory : Laboratoire d'Astrophysique de Marseille
City, Country : MARSEILLE

Title of the Internship :
Supervised techniques for adaptive optics performance characterization and astronomical images post-processing

Name of the tutor of the Internship :
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Summary of the subject :

Ground-based astronomical telescopes deliver time-varying images through the influence of atmospheric turbulence that blurs the image. In order to overcome this loss in terms of angular resolution, telescopes are now equipped with Adaptive Optics (AO) that are systems performing a real-time correction to restore the diffraction-limit resolution. However, the final scientific exploitation of these instruments relies on advanced post-processing tools as well, and one critical step, for both performance characterization and image post-processing, lies in the determination of the instrumental response of the AO, i.e. the Point Spread Function (PSF).

In this context, the R&D group at LAM is a worldwide leader in post-AO PSF identification and works actively to propose cutting-edge solutions, in close collaboration with large ground-based observatories, such as ESO, Keck and Gemini for instance.

We are currently developing a methodology based on convolutional neural networks (CNN) and supervised training techniques, with two identified tasks, (i) AO performance characterization from focal-plane images, and (ii) PSF identification from AO control loop data (wavefront measurements). The internship will focus on multiple actions :

1. Pursue the development of the CNN architecture and perform CNN hyper-parameters optimization using simulated Keck data and identify the best training parameters set for AO characterization from point-source images, in the presence of electronic/Poisson noise and telescope internal aberrations.
2. Simulate a large dictionary of AO control loop data using the Monte-Carlo simulations tool used in the context of HARMONI@ELT that will serve the training of a CNN dedicated to identify the AO PSF from those AO data.

3. If time permitting, the intern will test these tools on sky data already acquired at Keck, VLT and Gemini observatories.

The intern will work in closely with AO experts and astronomers at LAM and with international collaborators to gain expertise on both instrumentation, advanced post-processing and astronomy. This internship also gives the opportunity to handle real astronomical images obtained on-sky with various instruments (SPHERE, MUSE, GeMS, NIRC2) and a continuation in thesis is possible.

The salary will be 500€/month for a 6 months (minimum) internship and the internship will take place at LAM, 36 rue F. Joliot Curie, 13013 Marseille.

Keywords :

Adaptive optics, image processing, Machine learning, astronomy

Required skills :

- Background in Image/Signal processing
- Background in Fourier optics and instrumentation
- Programming skills, especially Matlab/Python
- Knowledge of Machine learning and programming with Keras/Tensorflow is an asset