



7 Research Positions

at the Delft Center for Systems and Control

In the Advanced European Research Council Grant iCON

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Project title: "Integrated Real-time Feedback Control and Post-processing for Image Restoration"

To integrate the advantages of the real-time AO (Adaptive Optics) correction of images with those of post-processing smoothing methods - while overcoming their drawbacks - a new unified framework is developed in this project, to retrieve in real-time closed-loop experiments the information necessary to perform high performance image smoothing in the post-processing mode. In the real-time mode system identification and feedback control of multidimensional systems are used to acquire the temporal and spatial dynamics of the wave front aberration under dedicated experiments optimizing all degrees of freedom of the deformable optics device. This dynamic model is used in the post-processing mode to achieve image restoration at the diffraction limit and beyond. The integrated approach will also help to remove the barrier of transferring the AO technology from the lab to the end-user by exploiting dynamic feedback in making better cost-effective high-resolution instrument designs. To enable to deal with the dimensionality of the image restoration problem, even when using compressed sensed CCD images (order 10^4 channels) and/or the large number of actuators (200 by 200 array as in the forthcoming extreme AO for the E-ELT) and the spatial-temporal dynamics of the wave front aberration, requires the development of new distributed identification and control design methods that have off-line linear computational complexity or better and allow multi-core CPU/GPU's processing in real-time at kHz rate. This research goal is pursued in this project in 4 integrated, multi-disciplinary research objectives:

Objective 4

**High performance and low cost
Adaptive optics and integral
validation**

6. Postdoctoral Research fellows – 3 years

Starting beginning 2015

7. PhD Position – 4 years

Starting beginning 2015

In this step the real-time AO and super-resolution post processing methods are integrated to diffraction limited image restoration or beyond. To validate both the real-time correction and the post-processing two demonstrators will be developed.

Objective 1:

**System identification of the
spatial-temporal wave front
aberration dynamics**

1. Postdoctoral Research Fellow - 3 years

Starting beginning 2014

2. PhD Position - 4 years

Starting beginning 2014

Subspace identification methods will be developed to identify large scale spatial-temporal dynamical models for the complete imaging plant.

Objective 3:

Distributed Robust Feedback Control and Updating

4. Postdoctoral Research fellow – 3 years

Starting beginning 2015

5. PhD Position – 4 years

Starting beginning 2015

For the linear case of using a pupil plane sensor the challenge is to develop a distributed H_2 optimal control solution for the case of heterogeneous distributed systems in order to treat the spatially varying dynamics. Fundamental new research on robust distributed control for 2D heterogeneous systems defined on a finite support (finite field of view) is necessary for LTI and Wiener systems.

Objective 2:

Experiment Design and Wavefront Reconstruction

3. PhD Position – 4 years

Starting beginning 2014

A complicating factor in the image restoration is that the wave front aberration cannot be directly measured. A calibration step to determine the mapping between the image sensor output and the wave front is necessary to specify the cost function to be optimized in closed loop control.

Interested researchers with a background in Numerical Analysis, Image and Signal processing, and/or Systems and Control are urged to apply. Your applications should include a recent copy of your curriculum with 3 names of scientists, who can provide a reference to you, copies of 3 of your most prestigious publications or a summary of your MSc thesis (for PhD applicants) and 1 motivation page stating your interest in the project. Your application package should be emailed to Prof. M. Verhaegen at M.Verhaegen@tudelft.nl. From here more information can be required on the research project and on doing research in the Netherlands.