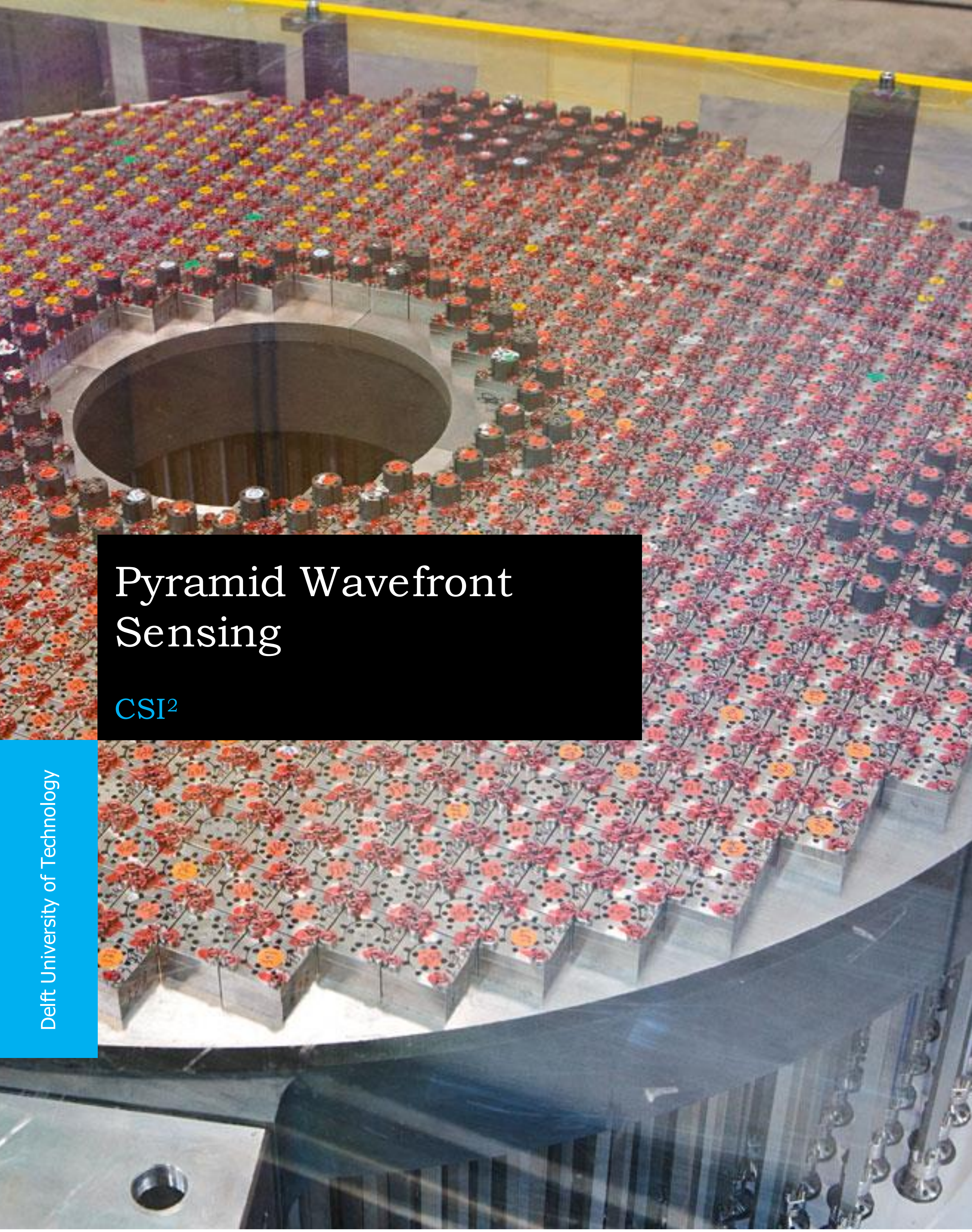
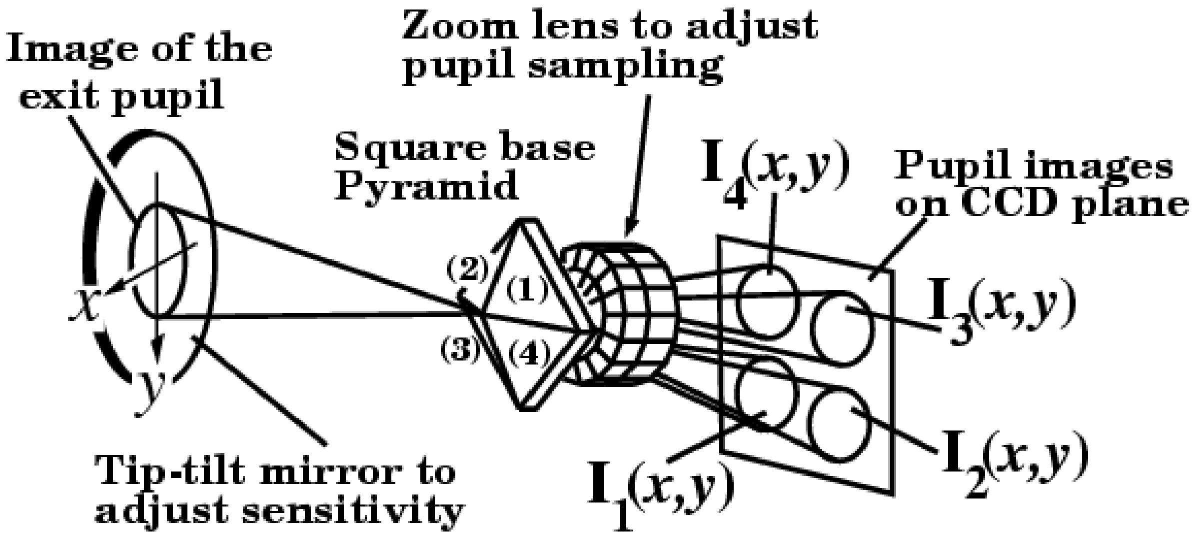


Pyramid Wavefront Sensing

CSI^2

Delft University of Technology

Delft University of Technology



Is the pyramid sensor suitable for wavefront sensing in the European Large Telescope?

Dr. Visa Korkiakoski & Prof. Michel Verhaegen


Room Number	34 C-1-310
Email	V.A.Korkiakoski@tudelft.nl
Project Term	2014-15
Keywords	Adaptive Optics, High-Contrast Imaging, Non-linear Control
Level	Bachelor's

Introduction

In the 2020s, three next generation extremely large telescopes become operational. These telescopes have diameters 20-40 meter, and they mean a revolutionary step in the ground-based astronomy. One of their most important mission is to find and characterize earth-sized extrasolar planets.

To reach the science goals, it is necessary to use an adaptive optics system to correct in real time the distortions caused by the turbulent atmosphere. The distortions have to be corrected faster and with a higher resolution than in any of the existing adaptive optics system.

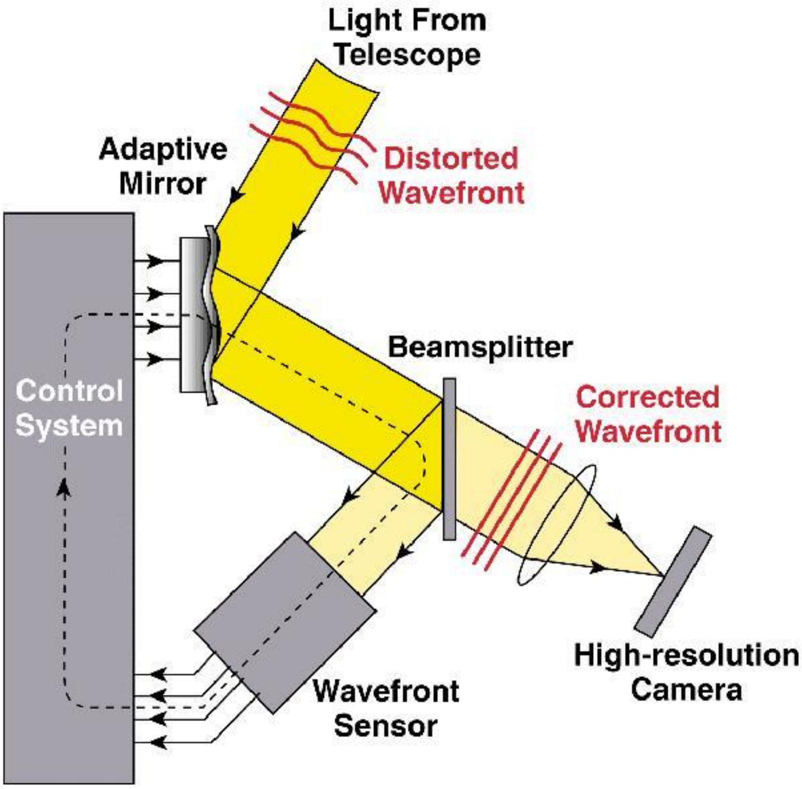
The recent research has established that the currently most common sensors scale up very unfavorable as a function of telescope diameter and the amount of degrees of freedom that needs to be controlled. With the extremely large telescopes, it is necessary to consider sensors that distribute the incoming light more efficiently in terms of the signal-to-noise ratio -- but have a more complicated non-linear response as a downside.

Research Question

DCSC, together with the Leiden Observatory, is conducting research to find out the optimal solution for the wavefront sensing for the high-contrast imaging applications at the European Extremely Large Telescope.

The student will study the performance of two possible wavefront sensor candidates: the pyramid sensor and the roof-top sensor. Currently, the latter sensor is the baseline choice for the European effort for next-generation high-contrast imaging; published simulation results confirm its suitability. However, the former sensor is simpler to implement, and its performance is also demonstrated in practice. Yet, simulations indicate it is more prone for diffraction effects arising when used with a very high spatial resolution. The goal is to see if we can find a method to deal with the diffraction issues to reach a comparable performance.

The study will take place with the help of computationally demanding numerical simulations. The simulations will be accomplished with a dedicated tool recently developed as a collaboration of several research institutes (ESO, LAOG, Leiden Observatory and DCSC). The simulations are numerically intensive, and they will be run in cluster of ~100 cores.



We are looking for students interested in diffraction optics modeling, programming, computationally intensive numerical simulations and non-linear control.