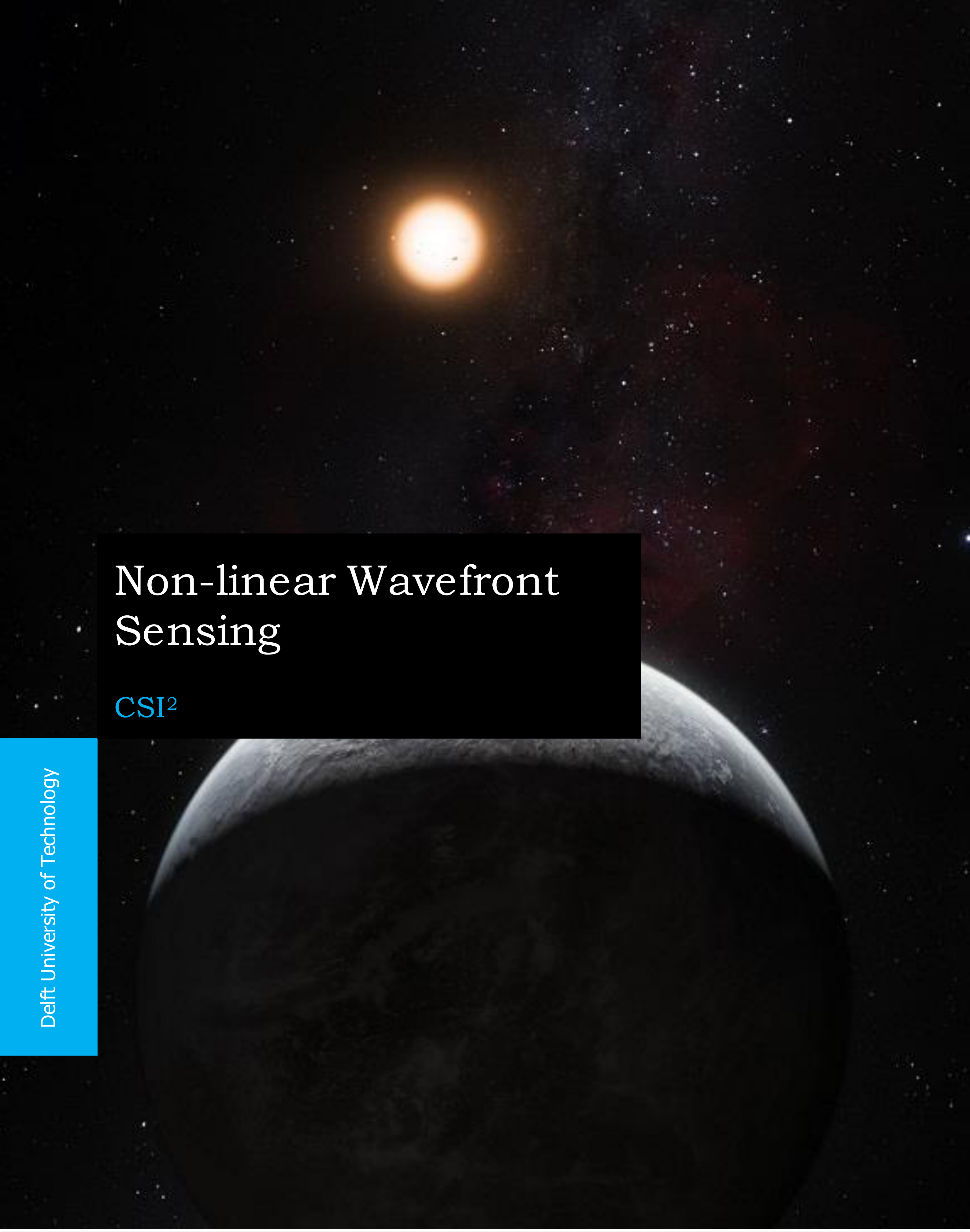

Non-linear Wavefront Sensing

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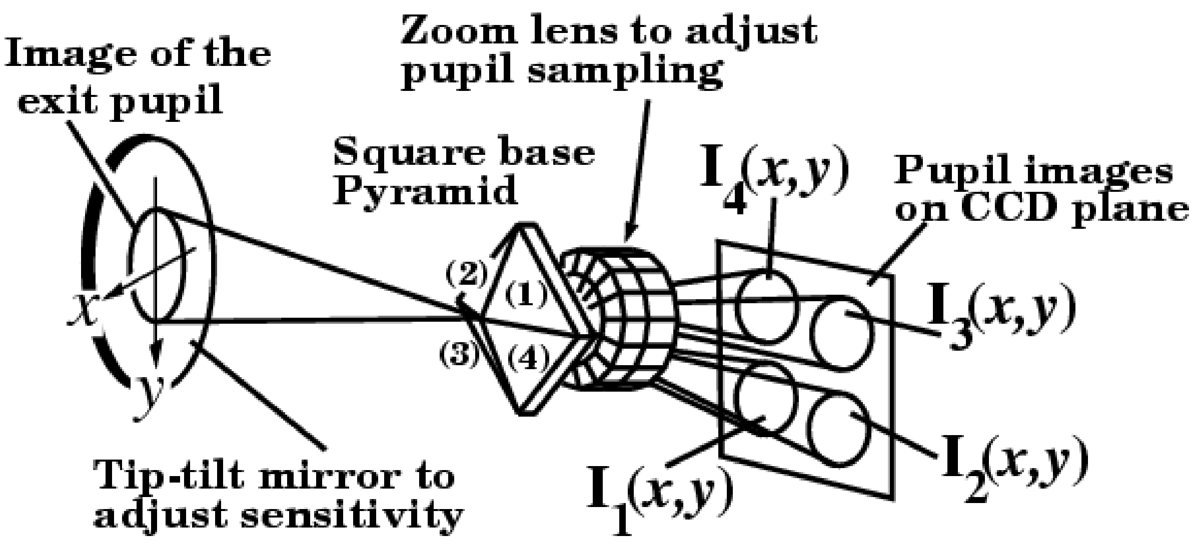

Nonlinear wavefront sensing for the exo-planet imagers at the next generation extremely large telescopes

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Project Term	2014-15
Keywords	Adaptive Optics, High-Contrast Imaging, Wavefront Sensing, Non-linear Control
Level	Master'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 system.

The recent research has established that the currently most common sensors scale up very unfavorable as a function of telescope diameter. Therefore, 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

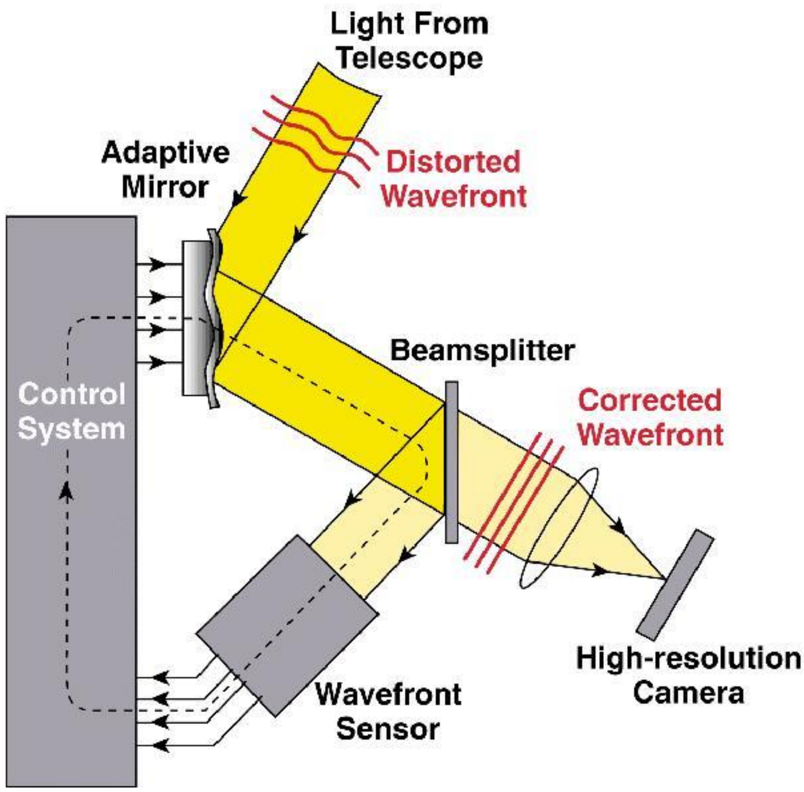
DCSC, together with the Leiden Observatory, is building a prototype sensor designed to be optimal the future high-contrast imaging applications. The new sensor is then integrated in an adaptive optics system capable of controlling 20.000-40.000 degrees of freedom; a challenge so far not addressed by any research group.

The optical setup consist of these major components: light source (a monochromatic laser), wavefront corrector (a high-resolution spatial light modulator), wavefront sensor (pyramid or a roof-top sensor), beam splitter and an imaging camera.

Approach

The student will perform the following tasks:

- integrate the components on an optical table
- write necessary software to drive the electronic components
- run the system such that it represent a realistic comparison to an astronomical case
- optimize the system performance
- compares the results with appropriate adaptive optics simulations.



We are looking for students interested in laboratory experiments, diffraction optics, computationally intensive calculations and non-linear control.