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Advanced Optical Metrology with a Smart Camera Device

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RCEU Proposal: Advanced Optical Metrology with a Smart Device Camera

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Project Summary

Metrology of optical systems requires different optical methods depending on the type of optic being measured and the fidelity necessary to ensure complete answers. The PI guided a Senior Design team from the OPE program in the development of a new optical test that can determine the basic shape parameters of a concave optical mirror. The system operates by taking two images of a specifically designed target in reflection from the mirror, running image processing software on the two images, and computing two fundamental parameters that define the surface: the radius of curvature and the conic constant. This project will begin by exercising the algorithm, both experimentally and with optical models of the system, to determine the fundamental limits on the kinds of mirrors it can test. Depending on the student, it may be possible to add capabilities to the current phone App, extending its capabilities to achieve finer detailed measurements, less stringent precision in acquiring the data, or both.

Over the course of this program, the student will learn by instruction, independent review and independent laboratory activity various forms of optical testing available to an optical engineer or scientist for optical mirror systems. The PI will provide an overview of the fundamental basis of the measurements and training in its implementation. The student will perform computer analysis using commercial optical design codes to evaluate the performance of the App over a variety of different mirror forms. Lecture notes and results of the modeling will provide a basis for a report written for the project, with the results of that experiment documented and analyzed. The intent of this report is to produce both future proposals and publications.

Student Prerequisites

The student must have a science and/or engineering background. Experience in using computers is a necessity, and programming, such as MatLab, is desired. Courses in geometrical optics and/or physical optics would be an advantage.

Student Duties

The student will be responsible for taking measurements using a variety of optical instruments. The student must follow all rules for safety and proper lab techniques for each measurement. The student will be responsible for fully documenting and recording all data taken during the program. The student will perform brief research into each test in order to more fully understand the experiments being performed.

Mentor Supervision and Interaction

The PI will provide training and assistance for all optical tests being performed. This will include both a lecture format and lab training. Meetings will nominally be occurring daily. The student will also interact with CAO staff and graduate students who can provide assistance with locating necessary optical components and operating the equipment.