



UNC CHARLOTTE

The WILLIAM STATES LEE COLLEGE of ENGINEERING

Senior Design Project Description

Company Name	<i>Center for Precision Metrology</i>	Date Submitted	<i>4/30/18</i>
Project Title	<i>Instrument Transfer Function Tool Box (CPM_TOOL)</i>	Planned Starting Semester	<i>Fall 2018</i>

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project. 250 hours are expected per person.

Complete the following table if this information is known, otherwise the Senior Design Committee will develop based on the project scope:

Discipline	Number	Discipline	Number
Mechanical	3	Electrical	
Computer	1	Systems	
Other ()			

Company and Project Overview:

Center for Precision Metrology (UNCC) industrial affiliates require a method for evaluating fidelity of the response of optical instruments for the measurement of part geometry over different lateral scales. The evaluation is typically performed using custom artifacts which have to be tailored to the physical principle of the measurement. The team will design both the artifacts to be used and a data reduction system.

Project Requirements:

The project objective is to design and build a system capable of measuring the Instrument Transfer Function (ITF) for a variety of optical metrology tools ranging from interferometers design for very smooth surfaces to fringe projection systems for rough surfaces.

In the context of measuring height variation of a surface, ITF is defined as the ratio of measured height to true height as a function of spatial wavelength. At the start of the project, the team will review measurement methods, test artifacts, and algorithms described in the literature (with support from a graduate student).

Based on the literature review, the team will develop requirements and then design (typically some form of step) artifacts for measurement of ITF in:

- 1. A scanning white light interferometer*
- 2. A confocal microscope*
- 3. A Fizeau interferometer*
- 4. A fringe projection system*



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Concurrent engineering will be required as the different instruments may require different optical characteristics (and hence manufacturing and calibration processes) of the surfaces of the artifacts. Optimum step heights will vary with effective wavelength of the optical instrument to be tested

The team will also develop software to compute ITF. The software must have a GUI allowing the user to

- a. define the data type (vector, array) and the data format;*
- b. choose the calculation method; and*
- c. define the output*

The team will fabricate – or have fabricated – the artifacts which will be delivered in a protective shipping container together with the compiled software on a USB drive and a manual.

Expected Deliverables/Results:

- Analysis of artifact requirements to allow future fabrication of artifacts for instruments with effective wavelength and/or required surface characteristics no cover by the deliverable artifacts (see below)*
- Artifacts optimized for the 4 instruments defined above*
- Compiled MatLab software with a GUI*
- Manual*
- Test data on example instruments from the list above*
- Protective shipping case*

Disposition of Deliverables at the End of the Project:

Hardware to be delivered to the Director of the Center for Precision Metrology after the last EXPO

List here any specific skills, requirements, knowledge needed or suggested (If none please state none):

- One ME (at least) student should have taken or be taking “Waves and Optics” MEGR 3235 Technical Elective*
- MatLab familiarity*