UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE *of* ENGINEERING

Senior Design Project Description

Company Name	*Center for Precision Metrology*	**Date Submitted**	*4/14/19*
Project Title	*Optimization and Assembly of a Confocal Optic* **CPM_CONOP**	**Planned Starting Semester**	*Fall 2019*

Number of Teams Requested to work on Project:

Single Team (CPM funded) __1___ Dual Team ($10,000) _____ (check one)

Faculty Mentor

Stuart Smith

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*	2	Electrical	1
Computer	1	Systems	
Other (MET)			

*Pre-assigned Tara Newman and Alex Caviness

Company and Project Overview:

Center for Precision Metrology (UNCC) industrial affiliates identified a need for rapid optical measurements of component surface profiles. One effort to explore existing commercial instruments that might satisfy this need is an extensive comparative study has been undertaken. In parallel with this effort, this project seeks to overcome some of the already known issues with these commercial sensors. One particular problem is that associated with color confocal probes. These probes have the advantage of simultaneously measuring a range of profile heights and, as a consequence, are capable of rapid profile measurement. Our proposed solution is to use a monochromatic source. The drawback is that this will require the probe to be mechanically scanned. To increase the speed of profiling a high frequency dithering system and state of the art high speed FPGA processing will be employed.

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Project Requirements:

A confocal optic was manufactured to facilitate an optical measurement challenge to student teams from around the world. The culmination of the challenge was to use this probe to measure the thickness of glass plates (0.1 – 0.5 mm) at the ASPE (American Society of Precision Engineers) annual meeting, an international conference of around 500 engineers from around the world (also including the European and Japan societies).

The probes were prototyped and manually assembled. Generally, notwithstanding the lack of alignment control and assembly variability, the sensitivity of these probes made thickness measurements possible with uncertainties of a few micrometers. The objective of this project is to design, build, and test a set of fixtures for aligning the many optical components (two lenses, 1 beam-splitter, a laser, two pin-holes, and a detector). It will also be necessary to design and fabricate testing apparatus and implement voice-coil drivers for actuating the experimental testing facility.

There will be an additional feature added to this design so that it will be possible to use it for surface scanning. To do this, the objective lens assembly will be mechanically modulated to provide a methods for identification of the confocal peak. This peak will then be identified using FPGA algorithms and any shift of the peak provided as either analog (DAC) or digital (SPI) output for scanning control. Both of these tasks require experience in the design and programming of FPGA processors.

Expected Deliverables/Results:

See above

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 student with industry experience working in precision metrology environments (Newman)*
- *One ME student familiar with FPGA programming and electronic circuit manufacture*
- *MatLab familiarity*