UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE *of* ENGINEERING

Senior Design Project Description

Company Name	ASML US	**Date Submitted**	05/25/2018
Project Title	Stability of Mechanical Constructions (ASML_STAB)	**Planned Starting Semester**	Fall 2018

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	5	Electrical	
Computer		Systems	
Other (any, incl. Mechanical)			

Company and Project Overview:

ASML is the leading photolithography tool supplier to the semiconductor industry, and consistently one of the two largest semiconductor equipment suppliers in the world. We engineer, design, build, market, install and maintain the machines that print the majority of the semiconductor chips used in computers, cellphones and elsewhere.

ASML's headquarters are in The Netherlands, where the main engineering and integration site is located. The company also has two large engineering and production sites in the US: Wilton CT (ASML US), and San Diego CA (Cymer). Cymer produces the light sources that enable the lithography process. This includes Deep Ultraviolet Lasers (193nm wavelength - light path in air and water) and the Extreme Ultraviolet Light Source (13nm wavelength – light path in very low pressure hydrogen). ASML US in Wilton produces all variants (including DUV and EUV versions) of several major modules of the TWINSCAN® Lithography machine: The Reticle Stage, the Reticle Handler, and several optical modules, including Wafer Alignment, Wafer Level Sensing (topology mapping), and Actinic Light Uniformity Compensation. All EUV modules are designed to operate in ultra-clean vacuum environment. In addition, Wilton also produces the optical module of the YIELDSTAR® in-line wafer inspection tool.

This Student Project will be sponsored by the Mechanical Development Group of ASML US (Wilton), and will target one of the mechanical issues that are intrinsic to our capability to keep up with an aggressive roadmap, where our machines have to perform at ever decreasing error levels to enable printing ever smaller features on chips. The issue is the stability of mechanical constructions. It is especially important for optical modules, which require mechanical constructions to hold optical elements very stably from the time the module is assembled and optically aligned, throughout its design lifetime (years). The life of the module includes

"traumatic" events such as temperature excursions and exposure to vibration and shock, encountered mostly during shipping from the factory (CT) to the integration site (NL) to the customer (US, Europe, Far East, etc.), both "as integrated" into the machine being shipped, or "as standalone" field replacement unit.

In this project, students will develop a test rig to measure stability of mechanical constructions. They will do "before and after perturbation" measurements to detect microscopic shifts in relative position of components of "typical" mechanical constructions placed in the test rig.

Project Requirements:

The students, in consultation with advisors at UNCC and ASML, shall:

Outline a test plan of the tests and measurements to be performed.

Select (among the accessible precision metrology options at UNCC Center for Precision Metrology) measurement technique(s) suitable for detecting and quantifying sub-micron instability of mechanical constructions.

Outline methods for perturbing mechanical constructions, consistently with specifications to be provided by ASML (related to our shipping specs).

Conceptualize a test rig that is compatible with the accessible metrology tool(s). The test rig should accommodate different sample mechanical constructions, for example, bolted joints and kinematic mounts. Sample dimensions and interfaces with the test rig are to be defined by the students, based among other things, on practicality and convenience. Defining a "standard sample format" compatible with the test rig seems reasonable..

Engineer the test rig (including error budgets, expected measurement errors, etc.), and produce preliminary designs.

Down select to a proposed test rig design based on tradeoffs.

Finalize the design of the test rig.

Design and/or procure at least two sample mechanical constructions to be tested.

Build the test rig.

Test the samples according to the plan.

Write a report, including test results, lessons learned, recommended improvements, and conclusions.

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Expected Deliverables/Results:

- Recommended method for measuring the stability of mechanical constructions
- Recommended metrology architecture.
- Final test rig and sample design, including specifications and CAD models.
- Working test rig, including at least two samples
- Final report including test results.

Disposition of Deliverables at the End of the Project:

Test rig, samples, results, etc. may be presented at the EXPO.
Test rig and samples may remain at UNCC after completion of the project, for the purpose of re-use in subsequent ASML projects.

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

Periodic progress reviews with ASML (suggested weekly ~ 1 hour) on Skype
, 4 design review meetings at UNCC and/or Skype.

Skill/knowledge/interest:

- Mechanical Engineering with a strong interest in precision mechanics.
- Mechanical (or other) Engineering with a strong interest in metrology.
- Mechanical Engineering with a strong interest in design.
- Mechanical (or other) Engineering with a strong interest in testing.

At the outset of the project, ASML requires no specific knowledge beyond acceptable academics in Engineering. However, the individual(s) must be willing to dedicate substantial effort towards "on the job" learning in the areas outlined above.