UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE *of* ENGINEERING

UNC Charlotte – Lee College of Engineering - Senior Design Program

Senior Design Project Description

Company Name	ASML US	**Date Submitted**	11/18/2019
Project Title	Damping of Flexure-Mounted System **(ASML_FLEX)**	**Planned Starting Semester**	Spring 2020

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	1
Computer	1	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 power 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 ~ vacuum). 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 Development and Engineering Group of ASML US (Wilton), and will target a mechanical issue that compromises our capability to keep up with our

aggressive roadmap, where our machines have to perform at ever decreasing error levels to enable printing ever smaller features on chips. The issue is excessive vibrations of a precision platform, which is mounted on a complex set of flexures that enable its positional adjustment. At certain frequencies, the mechanical vibrations are amplified by the flexure system. The project will concentrate on conceptualizing, engineering, designing and building improvements to the flexure system that will reduce the transmissibility of mechanical vibrations to acceptable levels specified by ASML.

In this project, students will develop:

1) A computer model of the dynamics of the structure, including the flexure supports. The model will incorporate damping. (Damping can be added later to the model).
2) A simple physical "test structure", which is "dynamically equivalent" to the precision platform. If possible, ASML will provide the actual (undamped) flexure hardware, which is expensive beyond the budget of the student project. If the actual flexures can't be contributed, ASML will share specifications and give guidance to the students to enable them to construct a low-cost version of the flexures that captures their essential dynamic behavior. In either case, the students will engineer and build the test structure that is supported by the flexures.
3) Testing of the undamped flexure-supported structure, to produce baseline vibration transmissibility measurements, against which to compare improvements.
4) Multiple proposals for flexure dampers, preferably passive. One of the proposals can be a passive piezoelectric damper. (There is a previous UNCC-ASML Senior project, which focused on active piezoelectric flexure dampers, and also operated them in a passive mode ASML_PIEZO, also reference ASML_STAB and ASML_DAMP previous projects). There may be somewhat useful findings and hardware from that project available to the students. Modifications or redesigns of the flexures may be proposed as well.
5) A trade table and selection of the best practical approach with the highest potential to meet specifications.
6) A physical proof of concept, comprising the test structure with dampers installed in the flexures.
7) Testing of the proof of concept and comparison to the undamped baseline.

Project Requirements:

In order to achieve these goals, the students will need to become skilled in:
Modeling of simple structures.
Modeling of vibrations and damping.
Conceptualization, development and mechanical design of a flexure-supported structure.
Techniques effective for damping flexible elements.
Testing and measurement of vibrations.
Electronics and software in support of the testing.

Expected Deliverables/Results:

- A simple flexure-supported structure that vibrates similarly to the actual precision platform (over a limited low frequency range). The dynamic model results of the actual precision

platform will be provided by ASML at the start of the project.
- Tests and measurements of the vibrations, damped vs. undamped
- A report with the design, analysis, conclusions, and test results

Disposition of Deliverables at the End of the Project:

Apparatus, results, etc. may be presented at the EXPO.
Apparatus may remain at UNCC after completion of the project, for the purpose of re-use in subsequent ASML projects, with the exception of the flexures. If provided by ASML, the flexures may have to be returned to ASML. This will depend, among other considerations, on whether there would be a follow-on to this project.

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, Design review meetings at UNCC and/or Skype.

Skill/knowledge/interest:
- Mechanical Engineering with strong interest in vibrations or mechatronics.
- Mechanical Engineering with strong interest in design.
- Mechanical, Electrical (or other) Engineering with 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.