INDUSTRIAL SOLUTIONS LABORATORY

Company Information

Company Name	*ASML*	Date Submitted	*05/11//2021*
Project Title	*Precision Mechanics Applications Including Metal Fusion and/or Other Methods* **(ASML_FUSION3)**	**Planned Starting Semester**	*Fall 2022*

Senior Design Project Description

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills.

Discipline	Number	Discipline	Number
Mechanical	5	Electrical	1
Computer		Systems	

Company and Project Overview:

ASML is the leading photolithography tool supplier to the semiconductor industry. 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 hardware engineering and production sites in the US: Wilton CT (ASML US), and 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 (13 nm 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 environments. 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 CT, 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 precise and stable positioning of critical elements of our machines.

In this project, students will investigate ways to use low-skill level metal fusion fastening, (for example resistive spot welding) to enable precise and stable one-time position adjustment and locking, suitable for precision mechanics devices.

This will be the third phase of a study partially overlapping with the Spring 2022 Student Project on the same subject. The students will learn from the achievements of the previous two teams, and inherit the hardware created by the FUSION 1-Fall 2021 team. This will provide an opportunity for the students to "hit the ground running" and familiarize themselves quickly with the issues with previous designs and start thinking about improvements. The students will also interact with the FUSION 2-Spring 2022 team and take full advantage of the one-semester overlap for knowledge transfer purposes.

Project Requirements:

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

Acquire a basic understanding of typical precision mechanics positioning devices, such as kinematic mounts and of precise adjustment/stable locking devices, such as micrometer screw driven stages and bearing slippers. Also study any other precision mechanics devices of possible interest for this project.

Brainstorm ways to replace and/or complement mechanical fasteners, such as screws, used in precision mechanics assemblies with low-skill metal fusion fastening means, such as (but not limited to) resistive spot welding and by extension gluing and fastening by plastic deformation of metals. The brainstorm should aim to produce a spectrum of ideas, from the almost trivial, such as replacing screws with permanent spot-welds to the very advanced, such as creating high shear strength fused joints that replace frictional bolted shear joints and can be disassembled and reassembled in the field. These two are only given as examples, and not meant to limit your creative thinking.

Research COTS low-voltage/high-current, compact (resistive or other low-skill) welding power supplies that may be suitable for use in a clean room. Consider engineering and building a compact (shoebox size or smaller) power supply that can be optimized for this type of application in the factory clean room for production, or in a semiconductor fab for repairs. (For your project, the clean-room compatibility requirement would be waived, provided you outline a path that others can follow to make your device clean room compatible, as part of a follow on project)

Down-select from the brainstorm results at least two ideas to propose to the sponsor for further development. The custom engineered power supply mentioned above would count as one idea, but is not mandatory.

INDUSTRIAL SOLUTIONS LABORATORY

Present the brainstorm and down-selected ideas to the sponsor. Negotiate and agree on one to three ideas to be further pursued by your team (the number of pursuits depends on their complexity).

Thoroughly familiarize and experiment with the inherited hardware/software. Draw conclusions for improvements of the device (quasi-kinematic interface) and/or production (welder, build fixturing) and/or test equipment (test rig(s), sensors).

Engineer proof(s) of concept for improvements (new or improved, or a hybrid of FUSION 1 and 2).

- Design the proof(s) of concept.
- Order all purchased components.
- Build and learn how to use the proof(s) of concept.
- Demonstrate and test the proof(s) of concept.
- Write a report, including test results, lessons learned, recommended improvements, and conclusions.

Expected Deliverables/Results:

- Conceptual design(s) of "proof of concept" according to the above.
- Preliminary Design Review (PDR) of the above to be attended/approved by the sponsor.
- Final proof of concept design(s), including specifications, calculations, models, BoM, etc.
- Critical Design Review (CDR) of the proof(s) of concept to be attended/approved by the sponsor.
- Working proof(s) of concept.
- Final report including test results and outline of way forward.

Disposition of Deliverables at the End of the Project:

Proof of concept hardware, software, results, etc. shall be presented to the public in full detail at the EXPO.
Proof of concept may remain at UNCC after completion of the project, for re-use in follow-on ASML-sponsored projects.

List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):
Periodic progress reviews with the sponsor (suggested weekly ~ 1 hour),
PDR and CDR meetings
All done virtually on Zoom, or equivalent.

Skill/knowledge/interest:

- Mechanical Engineering with a strong interest in precision mechanics.
- *Mechanical Engineering with Finite Element Analysis skills (structural, thermal).**
- *Mechanical Engineering with manufacturing (machining) skills.**
- *Mechanical Engineering with test set-up and general lab skills.**

- *Electrical Engineering with power electronics circuits skills**

*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.