

Selecting a project for 423L/523L Spring 2009

The optomechanical engineering laboratory requires an independent project. The main goals for the projects are:

- Learn and hone professional skills necessary for hardware development
- Learn practical hardware skills in one particular area
- Understand issues with real data/ hardware
- Publish results. (Many of these projects could be published as SPIE Conference Proceedings.)

The topics for these projects should be chosen so they are interesting to both the student and the instructor. Ideally, the project would allow a student to develop expertise in an area of special interest. Project must be chosen that can be completed within our capabilities at UA and within the single semester. The projects must be “hardware intensive.” Some design, analysis, modeling, and data processing will be required, but a significant portion of the project must involve real hardware. Resources are scarce to support this class, however, it is possible to purchase some hardware and components as long as

- the hardware can support some existing program, or
- the hardware will be valuable for us in the future, or
- the costs are small

(If there is a high likelihood of publication, then we are motivated to invest in hardware.)

This class is offered for both graduate and undergraduate students. It is assumed that graduate students will work independently, and undergraduate projects will either be performed in teams, or will be significantly less substantial than those for graduates.

Some possible projects:

We have brainstormed a number of candidate projects that look interesting to the instructors and may provide excellent educational opportunities. Students should review this list as a starting point, and feel free to suggest ANY topic for their project. These will be discussed in class and ultimately, both students and faculty must agree on the topic and scope for the projects.

Custom flexure design for adjustment.

Flexure design, fabrication (EDM)

Design for compliance, yield strength. Consider buckling

Measure 6 DoF stiffness

Determine performance (non-linear behavior, cross coupling)

Lens mount interface

Evaluate practical issues for lens seats (conical, spherical, sharp+break)

Manufacturability

Accuracy issues

Shock loading

Bonding for stability

Evaluate adhesives, methods for ultra-stable bonding
Implement methods
Evaluate stability, compliance, strength

Elastomeric adhesives

Investigate 6 DoF compliance
Study the coupling of bulk effect with shape factor
Measure adhesive and cohesive strength

Attachment of mirror to aluminum plate

Decouple lateral stress (flexure, elastomer)
Measure thermal effect on mirror surface distortion
Measure resonant frequency

Hexapod control

Design hexapod with linear actuators
Develop computer control interfaces
Develop control algorithm
Verify 6 DoF controls

Evaluation of displacement probes

Cross compare displacement probes
 LVDT
 Glass scale (Heidenhain)
 DMI (HP, Renishaw)
 Micrometers

Optical system layout

Use laser beam, apertures, PSD to align optical system with fold flats
Evaluate and analyze performance
Compare and contrast methods

Evaluate linear stages

Linearity of motion
6 DoF stiffness
Resolution
Repeatability
Accuracy

Evaluate non-linear damping of materials

Use piezo or electrodynamic drive, optical amplitude measurement
For different materials, measure the coulomb and viscous damping as function of amplitude.

Assembly, alignment of high performance linear drive

Assist with the measurement, adjustment, and validation of a 10-m drive system being constructed for measurement of a large mirror.

Design and construct an accurate solid rotary bearing

Calculate mating surface contact forces as a function of loads
Construct the bearing and measure its accuracy using a distance measuring interferometer

Error separation of two rotating bodies

Develop the math to perform the separation

Perform an experiment using a rotary bearing to demonstrate and validate the technique

Design and build on optics beauty inspection device

Design a dark field illumination system and implement it using the PSM as a base

Write NI image processing software to classify defects and demonstrate

Design and build an air floatation optical spherometer for aspheric measurement

Construction an air floatation frame using commercially available pads

Derive the math for measuring an aspheric surface

Demonstrate using LVDT sensors

Design and build a video readout to replace the eyepiece on an alignment telescope

Understand the optics involved with field of view and CCD array size

Perform an optical design and determine performance including distortion

Build the system using catalog lenses and demonstrate