NORTHERN ARIZONA UNIVERSITY

MSMA LATERAL LOADING DEVICE

MID-POINT PRESENTATION

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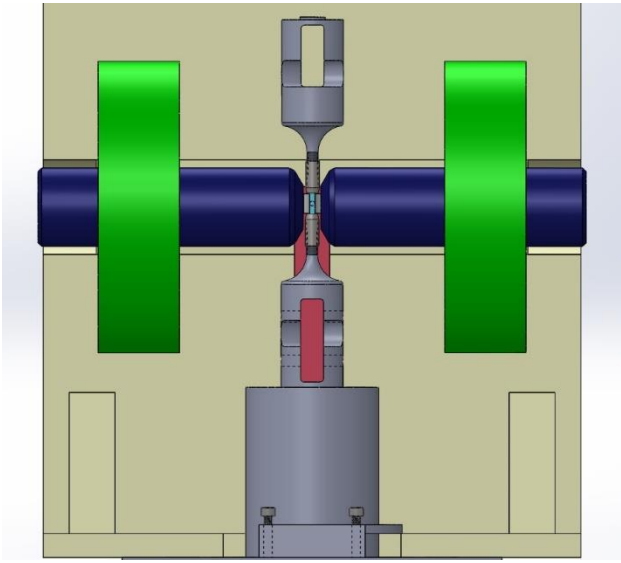
Overview

I. Problem Identification
II. Project Description
III. Design Concepts
    a. Actuation
    b. Force Sensing
    c. Improvised Design Changes
IV. Feedback System
V. Updated Budget
VI. Project Planning
    a. Gantt Chart
VII. Conclusion

Problem Identification

- Dr. Ciocanel
  - Conducts research on Smart Materials
  - Wants to expand his testing process to include compressive force in the third dimension
  - Operates at room temperature in a laboratory setting

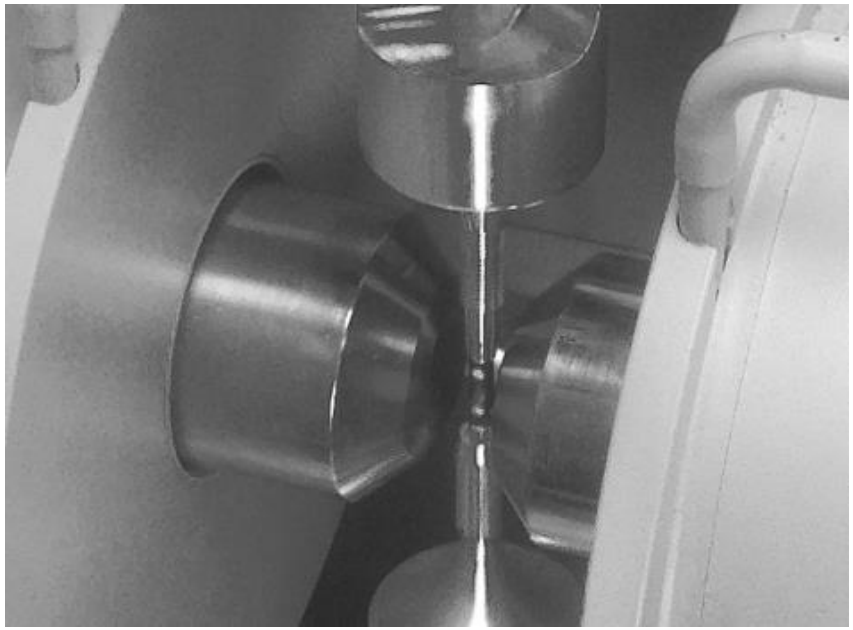
Solidworks Model of Instron Machine



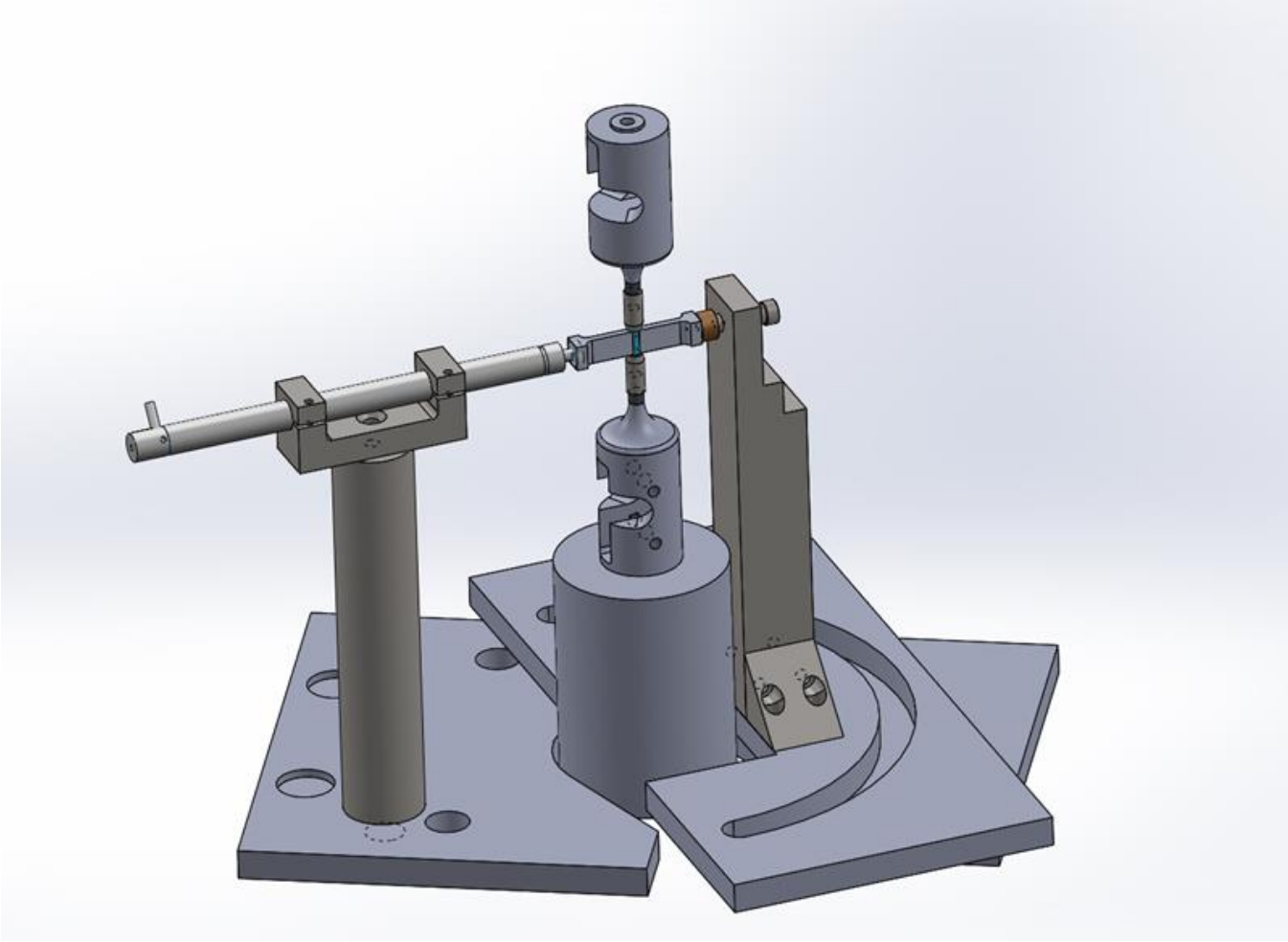
Project Description

- Construction of a device capable of laterally loading up to 200 N
- Work within a $2500 budget
- Fit within 10mmx12mm area under a magnetic field
- Provide feedback control

Experimental Setup for MSMA Testing



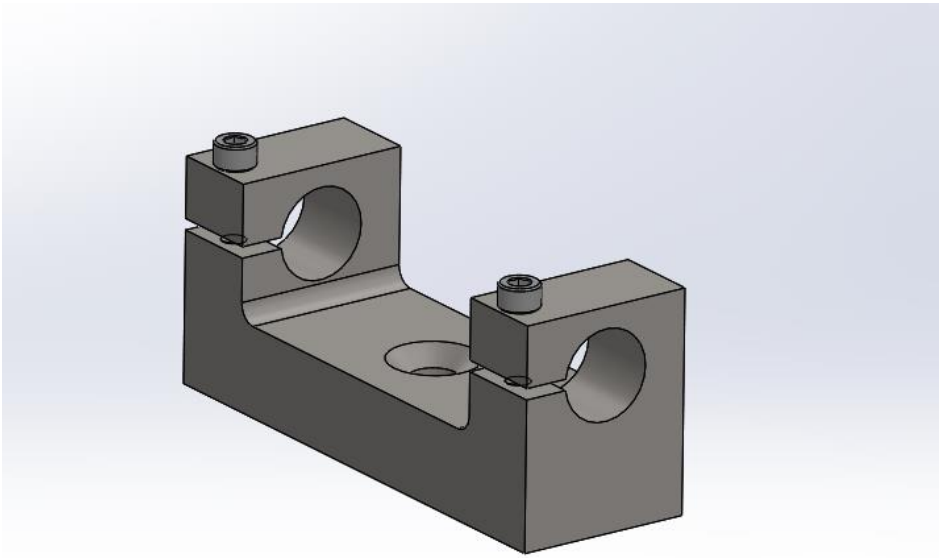
Design Concept



Piezoelectric Actuator

- THORLABS PAS015
- T-Cube Piezo Controller

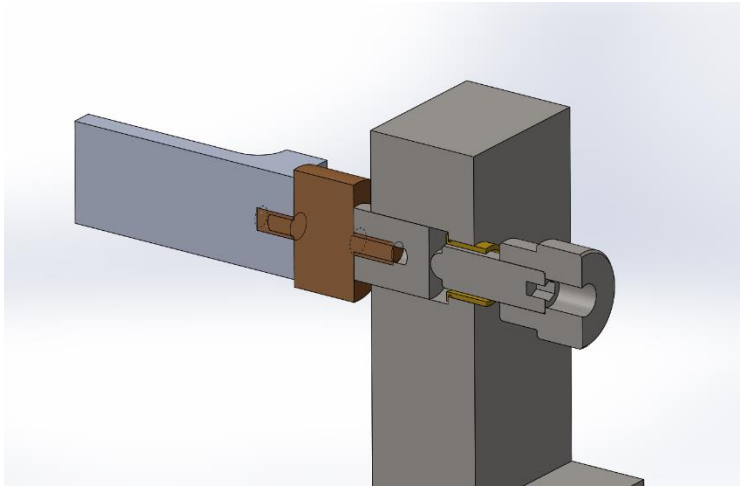
Piezoelectric Actuator Mount

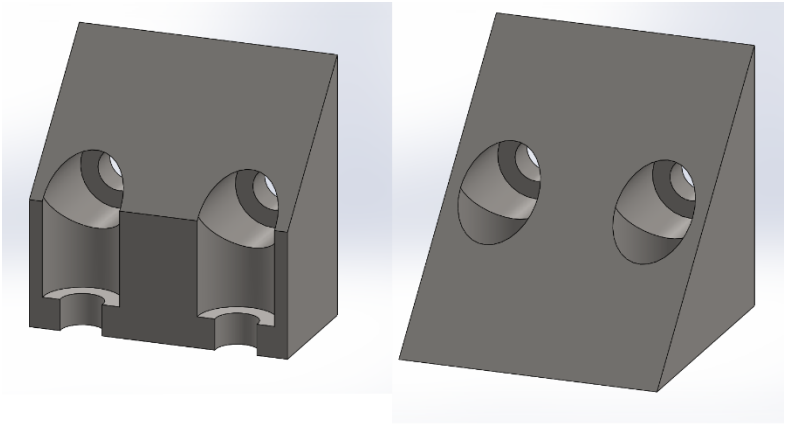


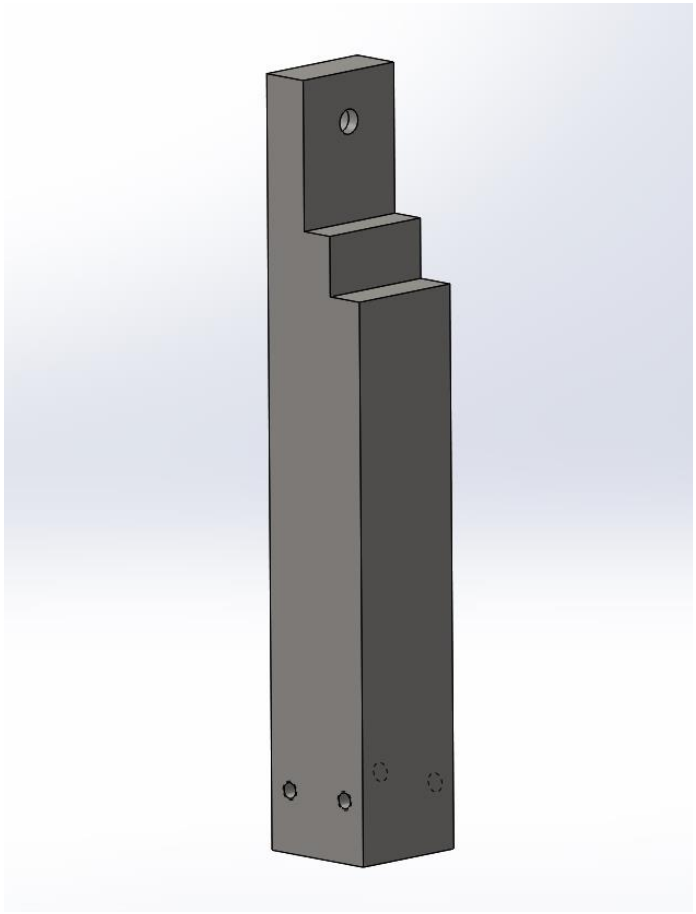
Strain Gauge Force Sensor

- Measures strain through voltage via deflection of wires attached to material.
- The selected strain gage is the Honeywell Model 11.

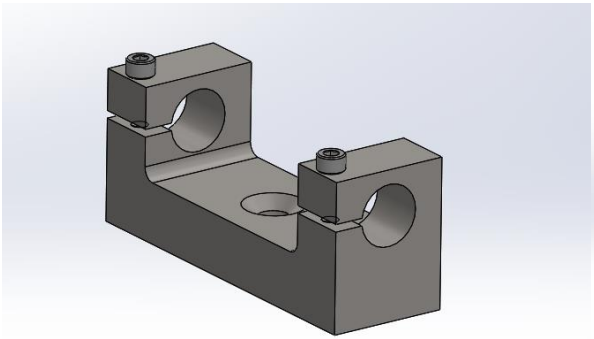
Strain Gauge Force Sensor Mount

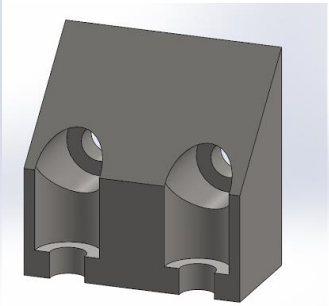


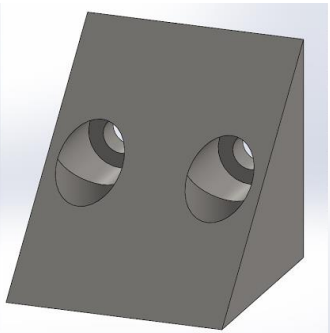


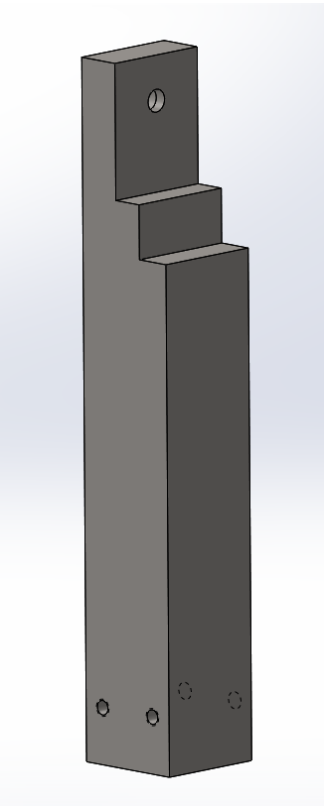


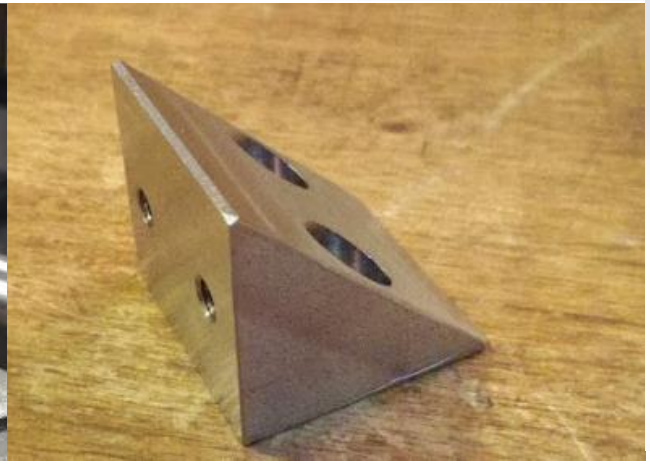
Improvised Design Changes





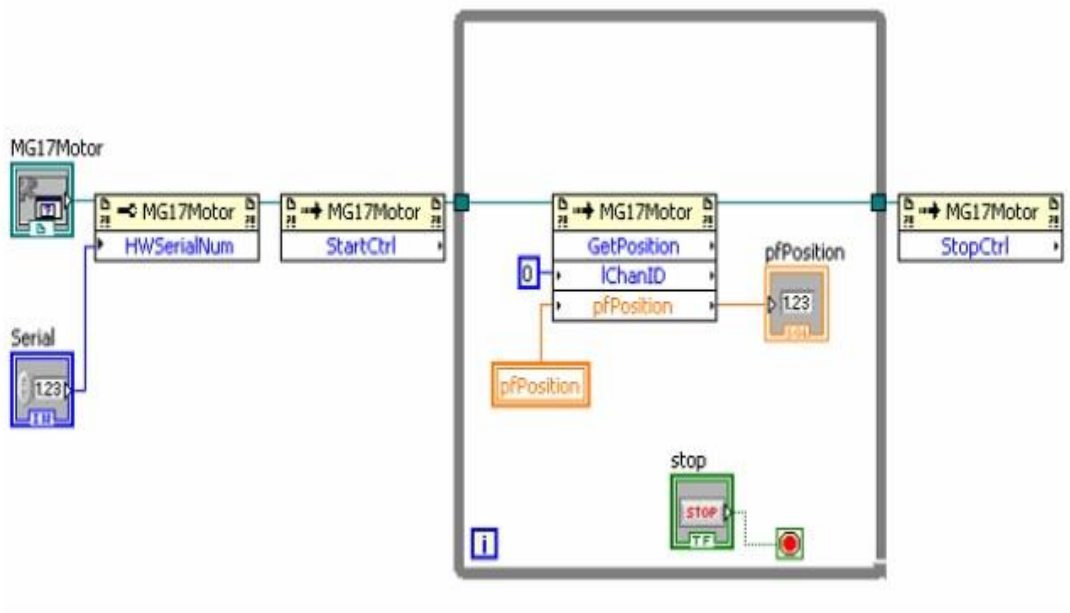






Feedback System

- Set Initial Force
- While loop
- GetPosition set using force sensor

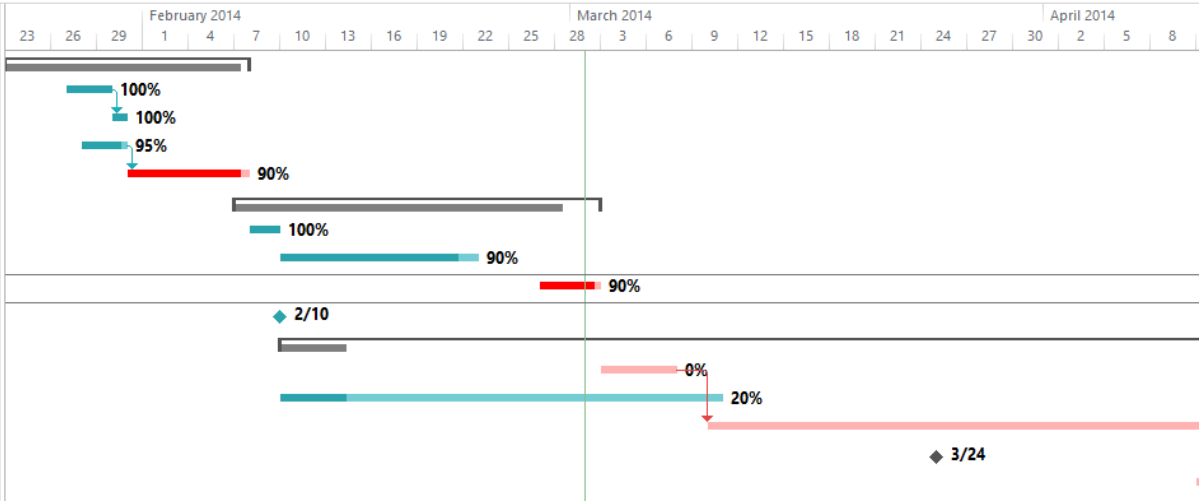


Updated Budget

Material	Cost
1.5" dia (1' length) 304 SST	$25.00
1" x 1.25" (3" length) 303 SST	$19.14
1.125" X 1.125" (11" length) 303 SST	$12.50
0.5" x 0.5" (3" length) 6061 extruded Alum.	$2.90
TB187-100-313 3/16 and 1/4 Fine Adjustment Carrier and Bushings	$3.75
KB187-100 Knob	$4.00
TS187-100-625 3/16-100 TPI Screw	$4.35
96006A259 6-32, 3/4" long Stainless Steel Socket Head Cap Screw	$0.86
90585A144 1/4"-20, 9/16" long Stainless Steel Flat Head Socket Cap Screw	$1.18
92220A173 10-32 1/2" Low Profile Socket Head Cap Screw	$9.44
UHMW Bearing, Flanged, for 1/2" Shaft Diameter, 5/8" OD, 1/2" Length	$15.96
THORLABS PAS015 Piezo-Actuator entire system	$2,370.26
Sales Tax	$4.96
Shipping	$24.50
Total	$2,498.80

MSMA Lateral Loading Device Time Line

% Complete	Task Name	Duration	Start	Finish
94%	**Finishing Design And Order Parts**	**12 days**	**Thu 1/23/14**	**Fri 2/7/14**
100%	Choose Actuator	3 days	Mon 1/27/14	Wed 1/29/14
100%	Order Actuator	1 day	Thu 1/30/14	Thu 1/30/14
95%	Complete Support Design	3 days	Tue 1/28/14	Thu 1/30/14
90%	Order and Obtain Materials	6 days	Fri 1/31/14	Fri 2/7/14
91%	**Manufacturing**	**17 days**	**Fri 2/7/14**	**Sun 3/2/14**
100%	Microtips	2 days	Sat 2/8/14	Sun 2/9/14
90%	Actuator Assembly	11 days	Mon 2/10/14	Sat 2/22/14
90%	Force Sensor Assembly	3 days	Thu 2/27/14	Sun 3/2/14
100%	Hardware Review 1	0 days	Mon 2/10/14	Mon 2/10/14
7%	**Build, Programming, and Testing**	**50 days**	**Mon 2/10/14**	**Fri 4/18/14**
0%	Build Setup	5 days	Mon 3/3/14	Fri 3/7/14
20%	Program Labview	21 days	Mon 2/10/14	Mon 3/10/14
0%	Test and Redesign	30 days	Mon 3/10/14	Fri 4/18/14
0%	Hardware Review 2	0 days	Mon 3/24/14	Mon 3/24/14
0%	Operations Manual	6 days	Fri 4/11/14	Fri 4/18/14



Conclusion

- Must create a feedback controlled device that laterally loads a MSMA up to 200 N within a small area for under $2500.
- The majority of the machining has been completed with the exception of the changes that need to be made after attaching to the base plate.
- The actuator and its component parts are in the team's possession.
- The development of a feedback system using LabVIEW has been started.
- The current tasks that are being worked on are the installation of the apparatus into the existing setup, development of the LabVIEW system, and the onset of testing.

•References

- [1] Leo, Donald J. Engineering Analysis of Smart Material Systems. Hoboken, NJ: John Wiley & Sons, 2007.
- [2] Garcia, Matt, Randy Jackson, Jeremy Mountain, Qian Tong, and Hui Yao. Material Testing Fixture. Material Testing Fixture. Dr. Ciocanel, 2012. Web. 15 Nov. 2013. <http://www.cefns.nau.edu/capstone/projects/ME/2013/DFMTM/index.html>.
- [3] "Model 11." *Model 11*. Honeywell International Inc, 2013. Web. 6 Nov. 2013.
- [4] "Piezo Driver Bandwidth Tutorial." *Thorlabs*. N.p., n.d. Web. 12 Jan. 2014.

QUESTIONS?