Seismic Sensor Test Fixture

Final Design Presentation
MECH/MECA 440B
May 6, 2014
Introduction

• Thank you to Lawrence Livermore National Laboratory
• Thank you to California Mechatronics Center
• Thank you to Dr. Johnson
Background

- Current seismic sensors have limitations
- CMC seismic sensor, consisting of an emitter and a target, is being designed to address these shortcomings
- This project will provide a means to test and verify output of a new sensor
## Specifications (Quantitative):

<table>
<thead>
<tr>
<th>Specification</th>
<th>Must Do</th>
<th>Should Do</th>
<th>Would Be Nice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution of motion in both dimensions</td>
<td>+/- 0.006”</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Accuracy of position in both dimensions</td>
<td>+/- 0.02”</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Remain Stationary</td>
<td>+/- 0.01</td>
<td>0.001”</td>
<td>0.0001”</td>
</tr>
<tr>
<td>Maximum Size</td>
<td>84”x42.25”</td>
<td>78”x32’”</td>
<td>32”x32”</td>
</tr>
<tr>
<td>Weight</td>
<td>1500 lbs</td>
<td>200 lbs</td>
<td>100 lbs</td>
</tr>
<tr>
<td>Maintain orthogonality between axis of motion</td>
<td>+/- 20 arc min</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>
## Specifications (Quantitative)

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Must Do</th>
<th>Should Do</th>
<th>Would Be Nice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Displacement (Bottom Axis)</td>
<td>+/- 2.75”</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Maximum Displacement (Top Axis)</td>
<td>+/- 3”</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>High Frequency Setting</td>
<td>6 Hz @ +/- 1”</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Low Frequency Setting</td>
<td>1 Hz @ +/- 3”</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Payload Capability</td>
<td>1 lb</td>
<td>5 lbs</td>
<td>10 lbs</td>
</tr>
<tr>
<td>Life Cycle (@30 sec intervals w/ 10 min rest)</td>
<td>500 cycles</td>
<td>5,000 cycles</td>
<td>50,000 cycles</td>
</tr>
<tr>
<td>Budget</td>
<td>$5000.00</td>
<td>$3,500.00</td>
<td>---</td>
</tr>
</tbody>
</table>
Design Solution
Motors

• Linear Servo
  ▫ Closed-loop operation
  ▫ Separate linear encoder required
  ▫ Separate linear guides required

• Linear Stepper
  ▫ Open-loop operation
  ▫ Microstepping drive
  ▫ Integrated bearings
Linear Guides (bearings)
Linear Encoders

- Magnetic scale tape
  - Adhesive tape backing
  - Simple installation

- Incremental scale with Index
  - 5 and 10 µm resolution
Design Changes
Resultant Design Changes
Fabrication

- 8 parts machined
- Thank you Transfer Flow, Inc
- Thank you Pro2Pro
Testing
Budget

TOTAL COST: $54,385.16

- Engineering Labor $37,582.20
- Fabrication Labor $1,000.00
- Outside Manufacturing (Estimate) $3,000.00
- Purchased Parts $2,285.02
- Raw Material $566.94
- Donations $9,951.00

Total Cost: $54,385.16
Budget

TOTAL FUNDING: $14,951.00

Sponsor Funds $5,000.00

Donations $9,951.00
Final Budget

- Thank you CMC and MMEM for adjusting budget
- Igus for free cable management
- Platinum Powder Coating
- Renishaw
- Nick Repanich for donated motors
Reflection

- Time is money
- Everything but top axis recording
- Built a $20,000 machine for under $5,000
Thank You!!

- Dr. Johnson
- Nick Repanich
- Jason Coates
- Transfer Flow, Inc
- Pro2Pro
- Steve Eckart
- Dave Gislon
- Scott Brogden
Questions