FINAL DESIGN PRESENTATION

Multi-Axis Positioning System for Precision Shaft Measurement
The Team

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Background

Micro-Vu is looking to open a new door in their metrology machines. Currently Micro-Vu has no options for high precision non-contact shaft measurement machines, and are looking to expand into this field.
Background

Normal Backlight – Light shoots in all directions bouncing off the shaft creating a false diameter on the probe for the shaft.

Telecentric Backlight – Light shoots straight and not at an angle, giving a proper diameter measurement.
Micro-Vu is looking to develop an automated multi-axis positioning system. The goal is to use the system in conjunction with an optical non-contact probe to conduct precise measurements of vertically oriented shafts.
Customer Requirements

• Budget of $15,000

• Support a vertically oriented shaft of 10kg and of max length 350mm and max diameter 80mm

• System must be designed in metric units

• Must have a tailstock, rotary stage, and linear axis

• Must have high precision and repeatability
Design Solution

Old Design

Current Design
Sensor Platform
Rotary Stage
Controller and Amplifiers

- Use of Galil 4133 Econo Motion Controller
- Computer Software: Galiltools
- Kollmorgen AKD Drive
- Advanced Motion Control Digital Amplifier
Motors and Power Supplies

- Kollmorgen Cartridge DDR Motor. This is powered using wall AC and a 24V logic supply unit as well.

- Kollmorgen AKM11B Servo Motor. This very small motor contains the necessary torque to spin our screw. Runs from a 75V power supply running at 2.7A.
Encoders and Feedback

- Renishaw RGH20 readhead and RESR encoder ring that carries a 0.1 micrometer pitch, which gave us a resolution of one ten-thousandth of a degree.

- Encoder built into the AKM11 for the linear axis. Which gave us a resolution of 1.2 micrometers.
Hardware Block Diagram
Purchased Parts
Fabrication
Fabricated at Micro-Vu
Fabricated in Chico
## General Testing

<table>
<thead>
<tr>
<th>Test</th>
<th>Spec</th>
<th>Pass/Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payload Shaft</td>
<td>10 kg</td>
<td>Pass</td>
</tr>
<tr>
<td>Maximum Shaft Length</td>
<td>350 mm</td>
<td>Pass</td>
</tr>
<tr>
<td>Maximum Shaft Diameter</td>
<td>80 mm</td>
<td>Pass</td>
</tr>
</tbody>
</table>
# Testing Rotary Stage

<table>
<thead>
<tr>
<th>Test</th>
<th>Spec</th>
<th>Testing Value</th>
<th>Pass/Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>100 mm</td>
<td>98 mm</td>
<td>Pass</td>
</tr>
<tr>
<td>Height</td>
<td>100 mm</td>
<td>85 mm</td>
<td>Pass</td>
</tr>
<tr>
<td>Speed</td>
<td>60 rpm</td>
<td>60 rpm</td>
<td>Pass</td>
</tr>
<tr>
<td>Accuracy</td>
<td>.05°</td>
<td>.002°</td>
<td>Pass</td>
</tr>
<tr>
<td>Repeatability</td>
<td>.005°</td>
<td>.001°</td>
<td>Pass</td>
</tr>
<tr>
<td>Resolution</td>
<td>.001°</td>
<td>.001°</td>
<td>Pass</td>
</tr>
<tr>
<td>Radial Runout</td>
<td>7 µm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Axial Runout</td>
<td>7 µm</td>
<td></td>
<td></td>
</tr>
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</table>
## Testing Linear Axis

<table>
<thead>
<tr>
<th>Test</th>
<th>Spec</th>
<th>Testing Value</th>
<th>Pass/Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel Length</td>
<td>360 mm</td>
<td>500 mm</td>
<td>Pass</td>
</tr>
<tr>
<td>Payload</td>
<td>3 kg</td>
<td>Weight of Sensors</td>
<td></td>
</tr>
<tr>
<td>Speed</td>
<td>200 mm/s</td>
<td>200 mm/s</td>
<td>Pass</td>
</tr>
<tr>
<td>Repeatability</td>
<td>7 µm</td>
<td>4.7 µm</td>
<td>Pass</td>
</tr>
<tr>
<td>Accuracy</td>
<td>10 µm</td>
<td>3 µm</td>
<td>Pass</td>
</tr>
</tbody>
</table>
Budget Cost

Total Budget Cost = $104,592
Budget Funding

Total Budget Funding = $104,592

- Engineering Hours, 91,000
- Galil 4133 Controller, 1345
- Manufacturing Labor, 3930
- Micro-Vu Funding, 8,317
Reflection

• Problems and Solutions
  • Machining to tight tolerances
  • Purchased parts

• Merits of Design Solution
  • Rotary stage
  • Simplicity of design

• Suggestions for future
  • Ease of disassembly
Acknowledgements

- Micro-Vu
- Anthony Franceschi
- Dr. V
- Nick Repanich
- AVL Looms
QUESTIONS?

The End