3 Point Bending Device

Group: Michael Harman, Xuan Nguyen, and Eric Sirois
2/19/09 Presentation by Eric Sirois
Project Overview

- **Construct a three-point bending device**
  - Capable of performing flexure testing on soft tissues
  - Capable of calculating the flexure rigidity, bending stiffness, transmural strain, transverse shear stiffness

- **3 Principle goals**
  1. Measure the stress-strain response in the low-strain region (<5%) by evaluating the instantaneous effective modulus, (E)
  2. Identify the location of the neutral axis
  3. Provide a suitable environment for testing (temperature, pH) such that data are relevant and repeatable
Critical Path Item

- The CCD camera has been identified as the critical path item
  - Most expensive
  - Most important to device success

- Ways to predict camera minimum requirements
  - Theoretically: performed as part of optimal design
  - Experimentally: requested by the client, is our current focus
Progress on CCD Camera

- Successful transmural strain pilot trial has been performed
- Used ink applied using a common toothbrush (based on an experiment by Fung, 1993)
- Image analysis (Xuan) revealed that markers were ~1 μm apart
Progress of CCD Camera

• Adding the diameter of the markers, a 2 µm pixel size has been determined to be appropriate
• Cameras exist with this pixel size, but field of view will be limited
  – 9 mm x 7 mm option ($900)
  – 7 mm x 5 mm option ($600)
• Slightly larger field sizes available at much higher cost
• We are ready to purchase, pending one final meeting with Dr. Sun (2/20/09)

http://www.mightexsystems.com
Completed Work

• All – significant emphasis has been placed on purchasing the CCD camera by end of week
• Mike – temperature control system and flow loop
  – Order has been placed for pump
  – Order for heater / thermometer pending
Completed Work

- Xuan – motor control, CCD output, and user interface (images on following pages)
- Eric – transmural strain calculation, meshing algorithm
Motor Control Block Diagram
Front Panel (carriage control)
Front Panel (image setup)
Hang-ups

• Temperature control – Mike has found a heater that could act as the temperature indicator as well
  – Waiting on quote for this
• CCD camera coding
  – Need to purchase camera
• Meshing algorithm
  – In final debugging phase
Future Work (1 Week)

• This week, we intend to:
  – Continue processing the images - Xuan
  – Continue implementing equations to process data - Eric
  – Fabricate the bending bar mount – Mike
  – Process pilot trial data using coded equations – Xuan, Eric
  – Purchase CCD camera, heating element, and temperature detector (if required) – Mike
Future Work (2 Weeks)

- Complete the bath/pump loop – Mike
- Validate equations using processed pilot trial data – Eric
- Work on implementing LabView code for motor control and user interface – Xuan
Future Work (1 Month)

• Perform pilot trials using CCD camera – Eric
• Build CCD camera mount – Mike
• Implement LabView code for CCD camera – Xuan
## Budget

<table>
<thead>
<tr>
<th>Item / Part</th>
<th>Projected Cost</th>
<th>Existing Alternative Available</th>
<th>Supplier</th>
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<tr>
<td>CCD Camera</td>
<td>$1000</td>
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<td>Sentech America, Inc</td>
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<tr>
<td>Computer</td>
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<tr>
<td>Tissue Bath</td>
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<tr>
<td>- Temperature Control</td>
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<tr>
<td>- Bath Materials</td>
<td>$240</td>
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<td>Grainger, msc</td>
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<td>- Flow Pump</td>
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<td>- Bath Solution</td>
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<td>Stainless Steel Bending Bar(s)</td>
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<td>Motor Parts</td>
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<td>- Stepper Motor(s)</td>
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<td>- 68 pin VHDCI to 68 pin VHDCI Cable</td>
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<td>- Linear Actuator</td>
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<td>Tissue Fixation Setup</td>
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<td>Total:</td>
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# Hours Worked

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<tr>
<td>Michael Harman</td>
<td>Friday, 1-5 pm</td>
<td>14</td>
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<tr>
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<td>Monday, 12-4:30 pm</td>
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<td>Tuesday, 12-2:30 pm</td>
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<tr>
<td>Xuan Nguyen</td>
<td>Friday, 1-5 pm</td>
<td>16</td>
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<td>Monday, 11-5 pm</td>
<td></td>
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<tr>
<td>Eric Sirois</td>
<td>Friday, 1-5 pm</td>
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<tr>
<td></td>
<td>Saturday, 2-5 pm</td>
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<tr>
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<td>Monday, 12-4 pm</td>
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Questions?