Fabrication of Percutaneous Transvenous Mitral Annuloplasty Testing Device

Team 19
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Client: Dr. Wei Sun
Outline

Purpose & Background

Project Overview
- Water-bath & System of Mounting the Heart
- Pressurizing System
- Force Detection System
- Marker Tracking System
- Integration of Programming

Final Budget

Acknowledgements
Client: Dr. Sun

Request: A testing device that yields physical evidence regarding cardiac tissue response to constriction of the mitral valve

- Constriction of the mitral valve aims to reduce mitral valve regurgitation
- Method of Constriction:
Physical Structure of the Device
System of Mounting the Heart

- Horizontal Rods
- Metal Clamp
- Vertical Support Rod
Pressurizing System

(a) Unpressurized, open valve. (b) Pressurized, closed valve.
Height of the pressure head proportional to pressure achieved

For $P=120\text{mmHg}$, $h=1.6\text{m}$ (approximately)
Force Acquisition System
Compression Load Cell
- 5,000g maximum, 5V excitation

4 Cantilever Beam Load Cells
- 250g maximum, 15V excitation
Radial Force on the Mitral Valve Measure with the Cantilever Beam Load Cells
Amount of Applied Force

Before Applied Force

After Applied Force

Compression Load Cell Apparatus
Male and female components allow easy extension and connection of cantilever beam load cells.
Amplification modules give a gain of 100

The use of more than one module requires an external voltage source for the SCC-68 protooboard.
Setting up the DAQ Assistant
Calibration of Cantilever Beam Load Cell

Calibration of Compression Load Cell
Example Calibration Results

Calibration Results over 3 Trials

<table>
<thead>
<tr>
<th>Load (g)</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
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<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>10</td>
<td>0.1</td>
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<td>20</td>
<td>0.2</td>
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<tr>
<td>50</td>
<td>0.4</td>
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<tr>
<td>500</td>
<td>2.5</td>
<td>2.6</td>
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Linear Trend line of Calibration Results

$y = 0.0049x + 0.0469$

$R^2 = 0.9975$
Preparing the LabVIEW Program

The diagram illustrates the process of preparing a LabVIEW program, focusing on scaling and mapping signals. It shows various stages of signal processing, including scaling and mapping signals, force measurements on different load cells, and configuration of scaling and mapping parameters. The diagram also includes a configuration window for scaling and mapping, allowing for the input of linear and logarithmic parameters to adjust the signals properly.
LabVIEW Program Interface for Force Acquisition
Marker Tracking System
Implementation of Markers for MTS
Program 1: Image Acquisition (coupled with load cell acquisition)
Program 2: Image Processing
Third program: Data processing

- Inputs 2 marker tracking .txt files, 2 calibration cube .txt files, and 1 file with arbitrary coordinates of the calibration cube
- Outputs position of each marker in 3-D field
- Volume of annulus throughout test
Device Outputs
The programming for the MTS and the FDS were integrated into one comprehensive program.

Data outputted:

- Force exerted on the wire suture that runs through the Coronary Sinus
- Force exerted on cantilever load cells by the constriction of the tissue
- Change in the geometry of the mitral valve
Conclusion
Since the PTMA testing device is capable of simultaneous force and 3-D geometry tracking, the client will be able to gain a better understanding of cardiac tissue’s response to various methods of constriction of the mitral valve annulus. This information will assist the client in discerning issues with specific methods of constriction and will serve as a basis for making comparisons between different constriction methods.
# Expenditures

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**Total:** $869.94
Acknowledgements

- Dr. Wei Sun – guidance and advice
- Shamik Baticharya – guidance and advice
- Thuy Pham – guidance and advice
- Kewei Li – assistance with marker tracking
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- Dr. Enderle – guidance and advice
- Sarah Britain – guidance and advice
- Jen Desrosiers – assistance with finances
- Marek – assistance with DAQ
Questions?