Appendix B: Experiment Design Report

Erin Sutton
Bioelectric Sensing and Navigation
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Experimental Design: Synthetic Phantom

Objective: Test if the prototype guidewire detects bifurcations, widenings, and stenoses as expected in a synthetic phantom.

I. Setup
The phantom is placed in a bath of 0.9% saline solution. A camera records the trajectory of the guidewire through the phantom as it is drawn through the six main paths at 1-2 mm/s.
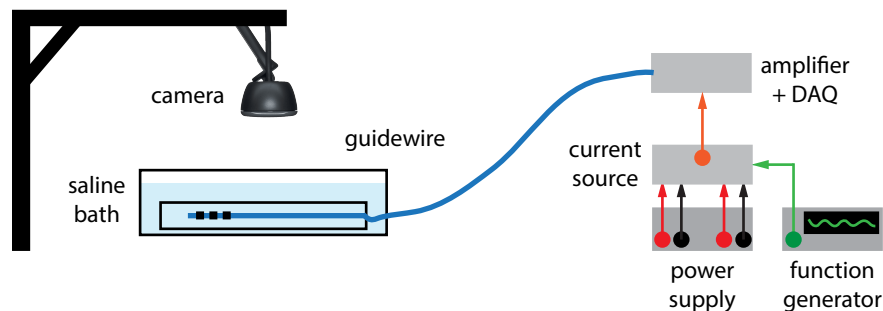

Figure 1. *Experimental Setup*. The phantom is placed in a saline bath. A camera captures video as the guidewire advances through the phantom. A power supply powers the constant current source, and a function generator provides the input AC signal to the current source. The measured signal from the guidewire is amplified and recorded by a DAQ.

II. Electronic Hardware
The input to the current source is ±5 mV at 730 Hz, and the current source supplied a constant 18 µA to the emitting electrode on the catheter. A neighboring electrode is grounded. The signal between the two electrodes is amplified and filtered by a low-power biosignal acquisition system (RHD2000, Intan Technologies, Los Angeles, USA). The Intan software (Intan Interface 1.4.2, Intan Technologies, Los Angeles, USA) logs the AC voltage measurement from the electrodes and filters the signals.

III. Phantom
The phantom for this experiment was custom-designed. The two halves of the phantom were machined from acrylic and sealed with a thin layer of transparent waterproof grease. When assembled, it measures 10 cm x 25.4 cm x 5 cm. It has eight paths, but only six are accessible with the non-steerable guidewire.
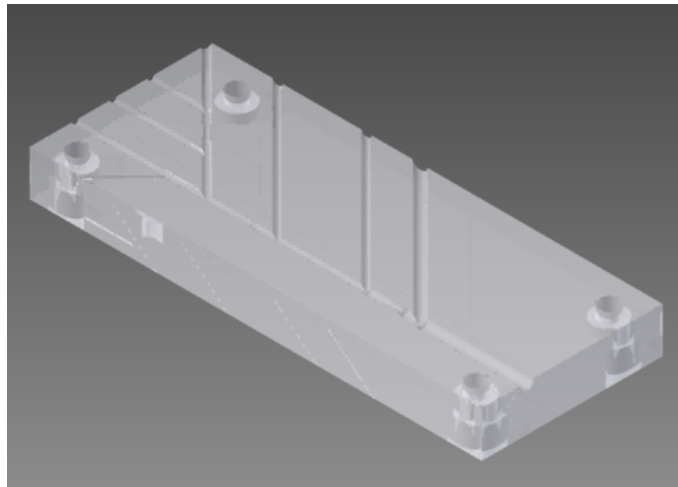
Figure 2. *Bottom Half of Vascular Phantom*.

V. Data Analysis

For each trial, the data is loaded into a custom Matlab script. A sliding window discrete Fourier transform converts the signal into the frequency domain, and the magnitude at the input frequency is extracted for each window. In this fashion, the input signal enables relatively simple path identification.