Experiments for Cardiac Catheter

In order to successfully produce reliable experimental results for the cardiac catheter, it is necessary to quantify the required information and outline an experimental plan. This document seeks to perform clarify these items.

Data Collection:

One challenge for this series of experiments will be accurately collecting the required data.

1. Force information:

   When manipulating the catheter, the force output generated by the actuator must be quantified accurately. A full time history of this output must be available for benchmarking purposes.

2. Catheter position information:

   Similarly, the position of the catheter must be accurately recorded. This can be done using machine vision (OpenCV). The entire configuration of the catheter should be tracked to validate the computer model. When implementing real-time feedback control, only the tip position must be tracked.

Potential Model vs Experimental issues:

1. Material property nonlinearity:

   The stiffness of the catheter is modeled as being constant. This assumption will likely break down at large deflections. Performing initial benchmarking tests to determine the effect of this nonlinearity is of the utmost importance.

2. Stiction, backlash, and hysteretic effects:

   These factors will likely influence the motion of the catheter. The importance of these factors must be determined.

Rough Experimental Outline:

1. Design and build and apparatus which can accurately actuate the catheter while recording output force data.

2. Perform a series of benchmarking trials.

   Perform (3) trials in which the force and catheter configuration are tracked while displacing its tip by a predetermined amount and back to equilibrium.

Make necessary adjustments to the model and ensure that the model is still a valid approximation

3. Perform in-flow trials.

   Perform (3) trials in which the catheter is placed in the flow field and made to reach a desired point using feedback control. These trials will be compared against uncontrolled experiments.