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Robotic Catheters:
An Experimental Platform for Haptic Feedback

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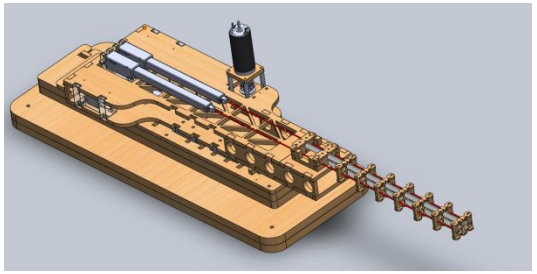


Above: CAD of Robotic Catheter platform

Introduction

Flexible Robotics is an exciting form of robotics that is capable of performing unique and different tasks not capable of traditional robotics. Snakes and worm robotics can be used to navigate narrow environments to perform tasks, while catheter robotics can be used for surgical applications such as ablation (cauterization of tissue) in the beating heart.

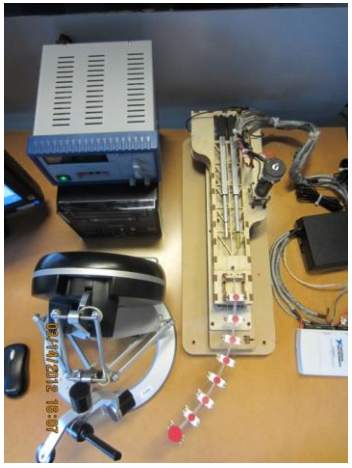
Instrumenting & roboticizing catheters can be useful:

- estimating the physical configuration of a catheter when conformed into narrow spaces
- Knowing the interaction forces with the environment.
- more intuitive, reproducible control of a catheter.
- Conteract loss of visual feedback, tactile and haptic feedback

Our Project --- The Haptic Catheter Prototype

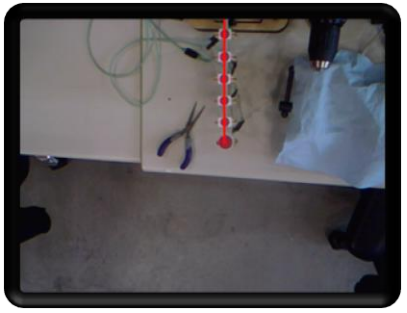
We have developed a general purpose flexible robot platform for investigating instrumentation and model-based methods for estimating robot configurations and interaction forces. Different instrumentation methods (Force sensor, cable potentiometer, camera tracking) versus mechanics model-based approaches are being evaluated and compared based on their cost, size, sensitivity, accuracy, etc. Catheter tip forces from measuring cable tensions is used for haptic teleoperation and also simultaneously mapping the environment, building walls, and exploring the workspace.

Above: Catheter Robot. Master Controller, Stereoscopic Camera Tracking, Haptic Feedback and Mapping of Environment.



Above: Top View of the Robot. 2 Degrees of freedom (Insertion and Curvature).

Bottom: Stereoscopic Camera Tracking using off-the-shelf webcams on 1024x768 video.



Bottom:
3DOF Master Controller, vertical DOF disabled.

Future Work:

- More degrees of freedom = more interesting configurations
- More sensor feedback will improve position accuracy
- Novel Applications

Interested in more information? Contact: mcyip@stanford.edu