FYP: Design of Experimental Procedures for Concentric Tube Models

Laboratory of Motion Generation and Analysis
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Background

A continuum concentric tube robot is formed by inserting super-elastic tubes concentrically into each other. The concentric tubes are initially designed as active cannulae for use in minimally invasive surgeries (MIS). As concentric tube robots have compliant structures, the modelling of concentric tubes is difficult. The core equations are differential equations that are derived from equilibrium of force and moment, and are solved through iterative approach. The proposed improvements in concentric tube models must be verified experimentally with a testbed and appropriately designed experimental procedures.

Problem

A testbed (see Fig. 1) that is able to accommodate the tube combinations of up to three super-elastic tubes has been desgined. The assemble of the testbed is to be conducted. The testbed also requries the super-elastic tubes to be fitted through custom-made tube holders, which are to be designed and manufactured. In addition, the experimental approaches to apply the desired external loads precisely on the tube as well as recording the final shape of the concentric tube robot are to be developed.
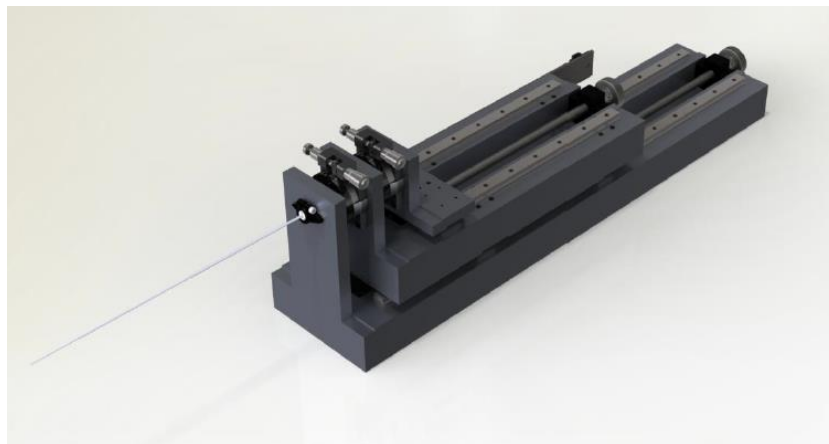

Fig. 1. The CAD model of the testbed.

Objective

To establish the experimental procedures for verifying concentric tube kinematics models:
1.   Assembly of testbed.
2.   Design and manufacture of super-elastic tube holders.
3.   Develop the approach to precisely apply the external loads of the desire kinds, directions and magnitudes onto the concentric tube.
4.   Develop the approach to precisely measure the shape of concentric tube robot, the tip position and orientation, as well as relative twist angles between super-ealstic tubes.

Requirements

One student in Mechanical, Mechatronics, or Aerospace

Contact

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