Abstract

Development of a Software Tool for Automatic Path Planning of Continuum Robots in Stereotactic Neurosurgery

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This thesis deals with accessing DICOM data and as well as path planning for concentric tube robots. A Graphical User Interface is made to ease the use of simulation tool `PyCTR`. Another Graphical User Interface is also made to access DICOM data using Python library `PyDicom`. Calculation based on the structure of the tube's curvature is used to identify the position of the tip of the tube. Based on the radii, the arc length of the circles, and the number of circles, a 2D path can be calculated and drawn. Defining the number of circles, the desired position, and the values of radii and arc lengths are essential to model an optimization. A self-made optimization is made based on random values of radii and lengths. The optimization runtime is compared with two other unconstrained optimization methods in the `SciPy` library, such as NELDER-MEAD and POWELL. The visualization is done by dividing each of the circle's arcs into several segments with a certain angle and each of the segment's endpoints is drawn. Some problems still occur in the visualization due to the unconstrained boundaries of the optimization methods, and the negative value of the radius. The visualization still needs to be improved, so that the path calculated from the negative value of the radius can still be plotted. Using the `SciPy` library, constrained optimization methods such as `SLSQP` and `COBYLA` can also be done and compared with the unconstrained optimization methods for future works.

Keyword: Concentric tube robots, Continuum robots, Path planning, DICOM