3D Slicer – ROS Integration Final Report

Please provide a full-length report on 3D Slicer / ROS path planning software by **June 5, 2020 at 4pm**. This system should comprise the following components

- A 3D Slicer implementation to select a straight trajectory with the constraints (a) avoidance of a critical structure, (b) placement of the tool into a target structure, (c) trajectory is below a certain length, (d) maximizing distance from critical structures (as in Coursework 1).
- Use OpenIGTLink to translate the selected trajectory as a point into ROS. It is highly recommended to transfer structures to ROS for validation, but not a requirement. Care should be taken here to apply the appropriate transformation, a flip about the x and y axes:

$$\begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

  This transform can either be performed prior to transmit in 3D Slicer prior to or after in ROS.
- A ROS implementation to move a RobotModel so that its end effector is at a given position, determined from the point read from OpenIGTLink (as in Coursework 3).
- Use OpenIGTLink to translate the position of the end effector into 3D Slicer. Care should be taken here to apply the appropriate coordinate transformation as described above.
- Validation should be performed to demonstrate the selected point in 3D Slicer and the robot end effector are co-located. This evaluation should be performed in 3D Slicer and ROS.

The report should follow the format of:

- Introduction (1-2 pages, 16.6% of grade). Describe why integration between imaging processing and robotic simulation is useful in the context of medical applications. Why is using: (a) image processing, (b) robot simulation useful for medical applications. Finally describe the advantages to developing an end-to-end pipeline for a clinical setting. Consider both advantages in implementation (designing the system) and validation (assessing accuracy and robustness).
- Methodology (3-5 pages, 33.3% of grade). Describe in detail the components of the system (3D Slicer path planning, OpenIGTLink for data transfer from 3D Slicer to ROS, ROS implementation to move robot, OpenIGTLink for data transfer from ROS to 3D Slicer), and a detailed description of how information is transferred between components. Care should be taken to clearly explain where coordinate transformations and changes in data representation are necessary for data transfer between software components.
- Validation (3-5 pages, 16.6% of grade). Describe in detail how each component was tested to validate output was correct. Finally, end to end testing to validate the entire workflow should be described. Screenshots and data visualization can be used to demonstrate results.
- Discussion/Conclusion (1 page, 16.6% of grade). Briefly summarize the key conclusion for your end to end pipeline. What, if any, components would you change to improve performance and why?
- Code (16.6% of grade): all python scripts used should be provide. A brief readme to explain each component and how to run the end-to-end pipeline should be provided.