Master/Bachloer Thesis:

Robotics and Embedded Systems
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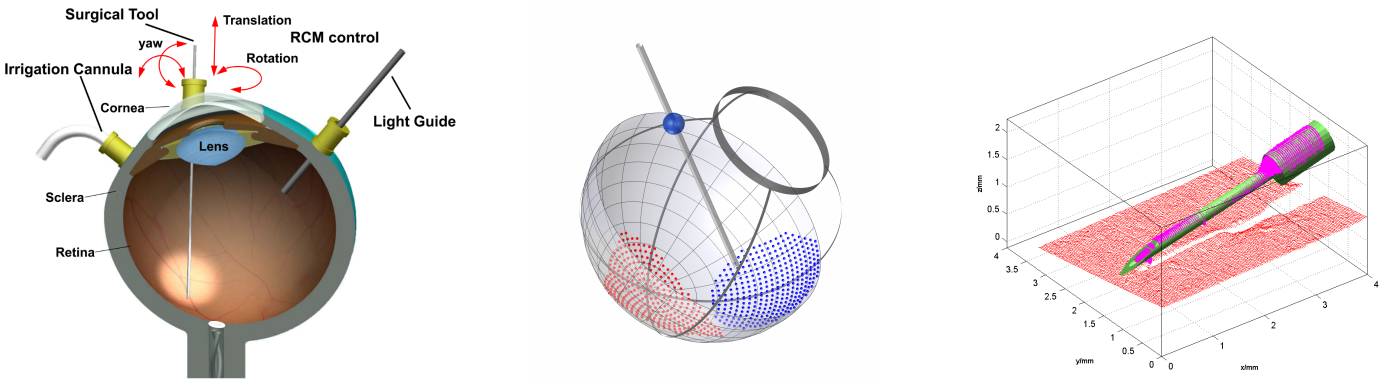
Machine Learning for the Ophthalmic Surgical Robot Path Planning under Optical Coherence Tomography Image Navigation

Project Description

Ophthalmic operation needs highly precision and delicate motion, (see Fig. 1(a)). In order to achieve this, a lot of study and train courses are required for a talented surgeon. The robot has a potential to accomplish the same task, eg. the sub-retinal injection, which is to deliver drugs inside eye under retina. However, this also needs a steep learning curve for tele-operation robotic system. The autonomous robotic system can assist surgeon to finish the operation more effective and bring a better outcome.

However, how to make the robot understand the valuable skill from the surgeon is a challenge for this autonomous system. Thanks to the development of machine learning, it is possible to give a certain of intelligence to the robot. It is still remain a interesting topic to generate a properly trajectory with a very high accuracy and multi-constraints. In our first step we would like to realize the automatic sub-retinal injection, which the surgeon inserts a needle inside eye, targets a specific area without other parts of eye, and injects the needle into this area with a optimized angle and speed (see Fig. 1(b)). These are the skills which the robot need to understand and learn.

We have already developed some algorithms for needle reconstruction via Optical Coherence Tomography (OCT) image, thus the needle tip position information can help to calibrate the motion system and feedback the control loop (see Fig. 1(c)).



(a) (b) (c)

Figure 1: (a)The sub-retinal injection surgery which needs highly precision and delicate motion, (b)The needle placement on the surface of retina, and (c)The needle reconstruction using OCT image cube.

Your Task

The project will include following phases:

- Understanding the inverse kinematics and forward kinematics of our robot, and learning one robotic simulation environment(we recommend V-rep or Gazebo).
- Familiar with some machine learning package, learning, and implementing one or two algorithms (Random trees, Genetic algorithm or Neuron inspired algorithm) give the path based on constraints and previous knowledge from surgeon.
- Write and conclude the results.

If you are interested in any part of research or technology in this project, please contact me for further information or potential topics for thesis/seminar.

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