

Development of Interactive Front-end Software for cisst/SAW Medical Robot Systems

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There are many different high school programs out there that promote robotics. However, all of these programs look at robotics as broadly as possible, and not within a specific field of robotics. One of these fields happens to be the field of surgical robotics. The goal of this project is to create a summer introduction to surgical robotics, as well as to create a simple and interactive API for teaching and research purposes.

We choose the language, python, for its interactive purposes, and the da Vinci Surgical Robot, for its teleoperational ability. However, please note that this course could extend to accommodate other types of surgical robots. We also planned a curriculum that would span a week or 5 days and that before participating in this curriculum, students should have an introductory level of programming. From this we developed the following curriculum with each day ending with a specific project:

- Day 1 - Introduction to lab and da Vinci Surgical Robot
- Day 2 - Motion in Translation Space
- Day 3 - Motion in Cartesian Space and Control of Gripper
- Day 4 - Sensing
- Day 5 - Final Project

An example of a project:

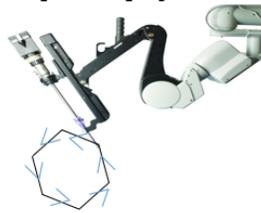
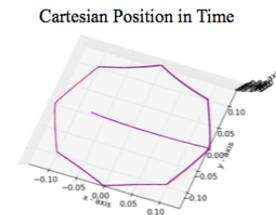


Fig 1: Have the robot trace an arbitrary regular polygon of a specified length.

Fig 2: Screenshot of a python program created as part of the project that helps us track movement of the da Vinci arm.



From this we realized that we needed to create an easy to use API for these students to move the robot around with. The da Vinci surgical machine uses both Cartesian movement and joint movement. Therefore, we gave them choices to move in both Cartesian space and joint space. We also decided to give them a choice of incremental motion, as well as absolute move. We also created other methods for easy control of the surgical robot. From this we created the following API:

Robot API
home
shutdown
get_current_cartesian_position
get_desired_cartesian_position
get_current_joint_position
get_desired_joint_position
get_joint_number
close_gripper
open_gripper
delta_move_cartesian
delta_move_cartesian_translation
delta_move_cartesian_rotation
move_cartesian

```
move_cartesian_translation  
move_cartesian_rotation  
delta_move_joint_list  
move_joint_list
```

We also plan to teach these students sensing with robotics as well as teach them motion parameters. Therefore, this API is far from done and will change in the future.