REMS Eye-in-Hand Registration

Computer Integrated Surgery II
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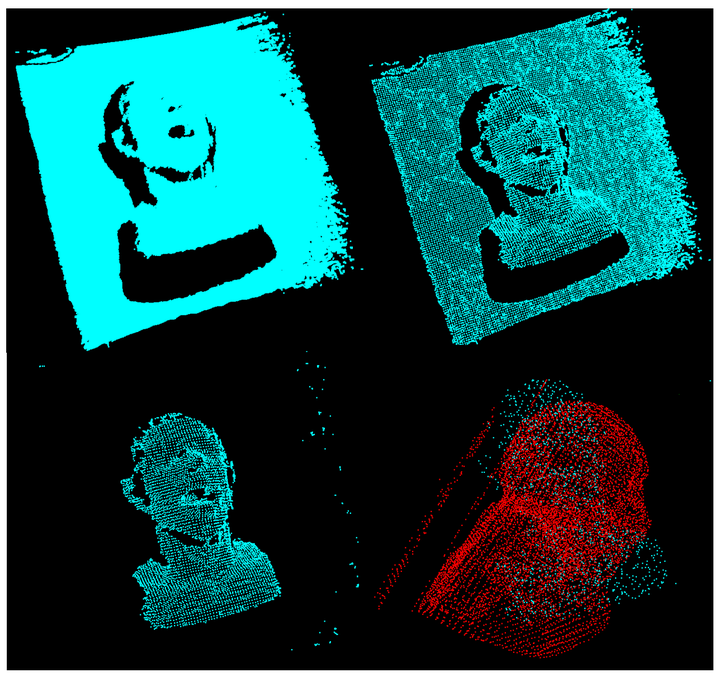
Introduction

- We developed a software package that processes point clouds from an Intel RGBD camera and registers them to a mesh model generated from a CT scan
- This allows robot operators to align the robot in a certain orientation with respect to the CT scan
- This addresses the general area of research of cooperative robotics in surgery, as well as registration algorithms



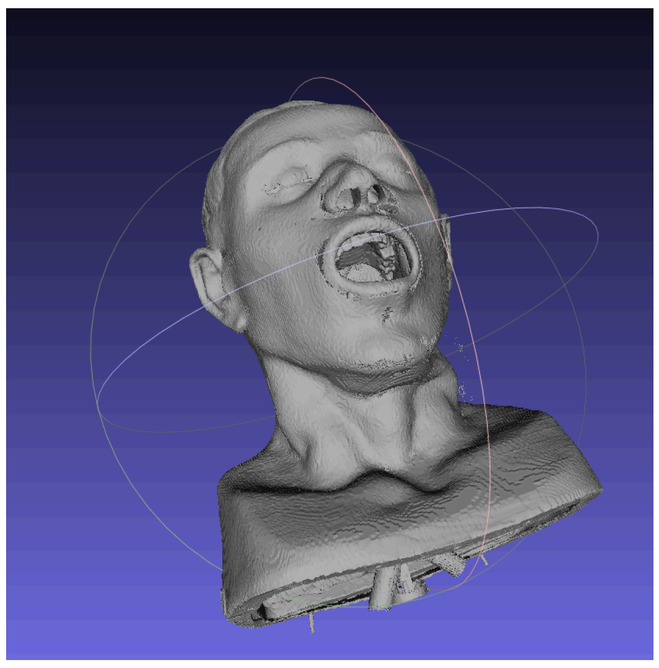
A visual progression from a raw point cloud to a registration to the mesh

The Problem

- REMS robot exists to help surgeons perform minimally invasive operations in the ear, nose, and throat
- For many of these surgeries, the starting pose of the robot over the patient is important, as it must navigate complex pathways through existing orifices. Small deviations from the path can result in damage to critical structures
- Planning the surgery using a pre-operative CT scan helps surgeons execute successful surgeries in this highly restrictive environment
- Therefore it is helpful for robotic systems to be able to tell or show surgeons how the real world relates to the CT scan

The Solution

- Registering a point cloud from the tool tip of the robot to the CT scan informs the robot user of the relationship between the patient under the robot and pre-operative scan
- We mounted an Intel RealSense camera to the REMS robot and developed a software package that allows the user to perform this registration



A representation of the mesh obtained from a pre-operative CT scan

Outcomes and Results

- Successfully process point clouds to usable state
  - Scaling, Downsampling, Segmentation
- Registration is error prone
  - ICP algorithm tends to hit local minimum
- Calibration routine successfully implemented
  - However generating poses needs further work

Future Work

- Calibration data processing
- Improved Registration Algorithm
  - Feature Based Registration
  - Other Forms of ICP
- Enhancements to User Interface
  - Better Visualizations
  - Other Forms of Feedback

Lessons Learned

- Dependencies are tough
- Registration is difficult in real world
- Importance of filtering data effectively

Credits

- Joe: Camera on Unix, Point Cloud Processing
- Zach: Registration, Calibration, Software Package

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