Progress Report

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Robotic Vision Lab

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1 Specific Research Goals

- VPQEKF (IROS - Mar. 1st): Work on the paper.
- DLO Manipulation Proposal: Work on a personal statement.

2 To Do

- Fellowship:
  - Develop a well-written personal statement. — On-going.
  - Seek other graduate fellowship opportunities. — On-going.
  - Develop multiple versions of research and personal statements for submission to different opportunities.
- ICRA 2022 Paper Review: On-going.
- PVQEKF:
  - Go over code and write matrix equations. — Done.
  - Write daily. — On-going.
  - Double-check my data prep implementation. Use KITTI Python module.
  - Test with Hilti dataset.
  - I need to separate the state observation and control input vectors from the z matrix. — Done.
  - Develop object tracking and robust-to-truncation feature.
  - Get ROS environment up and running. I need to install Armadillo (C++) with a certain dependency configuration.

3 Progress

The following items are listed in the order of priority:

- Fellowship: I worked on my personal statement on two occasions. I will write an outline for the DLO manipulation project and break it down into smaller projects.

- VPQEKF: I discovered a new bug in the algorithm where it used ground truth rotation instead of the previous state's posterior belief. It seems to work fine now, there are L1 and L2 errors ranging from single digit to six digit values.
- ICRA 2022 - Pose Estimation with Double Quaternion Particle Filter: I have read through half of the paper and I am enjoying it very much. I familiarized myself with dual quaternion representation and I find it preferable over normal quaternion representation. Normal quaternion representation uses *unit lines* or *unit vectors* $\mathbf{i}$, $\mathbf{j}$, $\mathbf{k}$ to represent a point (when $w = 0$) or rotation vector (when $||q|| = 1$). Simply put, Clifford extended Hamilton's quaternion to dual quaternion by using a second quaternion to represented Δi, Δj, Δk with $w = 0$. Furthermore, this SO(6) representation is reduced SE(3) by defining $\epsilon^2 = 0$ and using the Euler's screw axis. Dual quaternion simplifies pose and motion computation since it enables concatenation of translation and rotation matrices for batch computation while maintataining high numerical accuracy.
- NBV-Grasping Project: No update.
- PyTorch Tutorials: Transfer learning.
- Pose Estimation: I will need it for DLO segment localization.

4 Intermediate Goals - Fall 2021:

- QEKF: Finish paper.
- Active Learning.
- UR5e: Do the tutorials.