

Progress Report

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1 Specific Research Goals

- VPQEKF (April 1st): Work on the paper.
- DLO Manipulation Dataset (September - ICRA or IROS?)

2 To Do

- QEKF Paper - 30% extension (April 1st):
 - Edit VEst section and add updates.
- QEKF/QuEst+VEst Implementation (**Feb. 28th**):
 - Implement QuEst 5-point - On-going.
 - Implement VEst
 - Address scale factor (depth-scale) issues
 - Address "hand off" issue when objects enter or leave field of view
 - Real-time streaming images for real-time operation (optional)
 - Experiments
 - Feature point extraction
 - Noise issue: noise cannot be modeled
- DLO Manipulation:
 - Related work literature review
 - Real dataset + paper (September 2022 - ICRA):
 - * Watch IROS manipulation workshop videos.
 - * Design, discuss and build a data collection and test rig.
 - Unity dataset
 - * Recreate virtual duplicates of physical test material
 - * Model dynamics and deformity

3 Progress

The following items are listed in the order of priority:

- VPQEKf (April 1st, 2022): I am almost done debugging and rewriting the [1] source code; the issue at this point is the SVD function provided by Scipy as it has a different default configuration than what is implemented in Matlab. I tried a few different options as explained in the documentation but I was not able to resolve the issue. I messaged Dr. Gans tonight, he will probably respond over the weekend. In the meantime, I have debugged the code line by line, except at the very end. I even saved keypoints from Matlab in full precision and loaded them into Python implementation to check and confirm its computational integrity. This is needed since the RANSAC feature selects a different set of keypoints each time and we are solving large high order matrices where a small error could propagate into the computation. Moreover, in my implementation, first I find the most prominent keypoints and select the top 30. I perform the same on the next image frame and then I proceed to match the keypoints and find the top five correspondences with the highest cross-matched scores. Once this paper is submitted, I can quickly write additional papers by deploying different variations of the EKF filter, e.g. Unscented-EKF, Ensemble-EKF. Dr. Gans could provide more expert insight at a later time.
- DLO Manipulation: No update.
- Pose Estimation: I will need it for DLO segment localization.
- NBV-Grasping Project: No update.
- PyTorch Tutorials: Transfer learning.

4 Intermediate Goals - Fall 2021:

- QEKf: Finish paper.
- UR5e: Do the tutorials.

References

- [1] K. Fathian, J. P. Ramirez-Paredes, E. A. Doucette, J. W. Curtis, and N. R. Gans, “Quest: A quaternion-based approach for camera motion estimation from minimal feature points,” *IEEE Robotics and Automation Letters*, vol. 3, no. 2, pp. 857–864, 2018.