

Progress Report

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Robotic Vision Lab

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1 Specific Research Goals

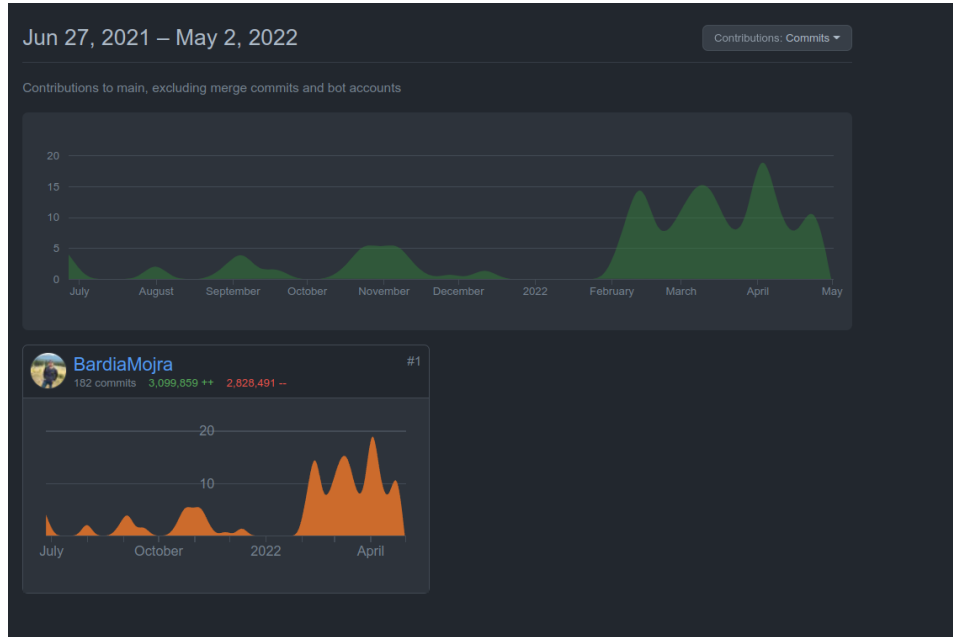
- VPQEKF (April 13th): Work on the paper.
- DLO Manipulation Dataset (ICRA - Sept. 1st)

2 To Do

- QEKF Paper - 30% extension (April 13th):
 - Edit VEst section and add updates.
- QEKF/QuEst+VEst Implementation (April 13th):
 - Implement and test QEKF in Matlab. Done.
 - OOP Integration: QEKF is done, QuEst is done but not tested, and VEst is remaining.
 - Feature point extraction: implement semantic segmentation
 - Address scale factor (depth-scale) issues: DL solutions?
 - Address "hand off" issue when objects enter or leave field of view
 - Real-time streaming images for real-time operation (optional)
 - Experiments
 - Noise issue: noise cannot be modeled - revisit
- DLO Manipulation: Sept. 1st
 - Related work literature review
 - Real dataset + paper (ICRA - Sept. 1st):
 - * 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 (**RAL - April 1st, 2022**): I tested QEKF Matlab and shared the results with Dr. Gans. Then, I worked on the integration part of the project. To integrate the three modules, I am deploying object-oriented programming (OOP) scheme for effective management. Everybody writes code, not many write useful code. The QEKF module is ready since it is already in OOP format. I finished porting in QuEst/main file to OOP format and began testing it. The source code has not and will not change since it is implemented in "Static" function style (each function in a separate file). Static functions can be used as-is in form of local 'scope' functions in Matlab OOP. I have not started working on VEst and I estimate it to take less than two days (that includes a day for testing). Moreover, the new QuEst code includes all other pose estimation methods implemented by Kaveh. The following figure shows my contribution to the QEKF project over the past 6 months.
- DLO Manipulation Milestones: Early in the week, I did some tutorials on Blender and began recreating the lab work cell area. Ideally, I will use Nvidia's Isaac simulation as I am confident they will use their trade secrets to achieve better performance on their hardware compared to all other competitors. Moreover, I strongly think adding projectors

to the data collection rig can significantly improve computer-assisted annotation. The projection can be used as closed-loop visual feedback and can be cross-referenced with the depth map. You can create robustness by cross-referencing high probability estimates. Please don't share this idea with anyone.

- 3D Scanner: It is needed for object manipulation and perception tasks.
- Pose Estimation ([DLO-01](#)): On-going under VPQEKf.
- Semantic segmentation ([DLO-02](#)): Per my discussion with Dr. Gans, I will explore DL methods for the depth or scale problem.
- Grasping Project ([DLO-03](#)): I am making this a part of the DLO project.
- PyTorch Tutorials: Transfer learning.

4 Intermediate Goals - Fall 2021:

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