

Progress Report

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July 9, 2021

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1 Specific Research Goals

- VPQEKF: Combine QuEst and Vest with QEKF paper.
- Pose estimation survey.
- NBV-Grasping.
- Universal pose estimation.

2 To Do

- Catch up on my reading list.
- PVQEKF:
 - Replace data input to QEKF, remove IMU data with QuEst and Vest data. – Done.
 - Update state definition and measurement matrices. – On going.
 - Get ROS environment up and running. – Next: test header include bug theory.
- Pose Estimation Survey: – On pause.
 - Categorize pose estimation research and create a mind map. – On going.
 - Implement key point feature extraction: ORB, SIFT, SURF.
 - Survey: I need start working on this. – On going.
 - Survey implementation: Classical, 2-stage, and end-to-end methods. PnP, QuEst, PVNet and else.
- NBV-Grasping:
 - Update URDF and Xacro files for UR5e to include sensor, sensor mount (with offset), and the gripper.
 - Add movement constraints for tables and scenes.
 - Write two IK functions for gripper and sensor, one for each. It should plug-in with MoveIt configurator.
 - Research and implement point-cloud data to training TensorFlow models.

- Learn and implement GraspIt package.
- MSI Fellowship: On pause.

3 Reading List

- Vision-based robotic grasping from object localization, object pose estimation to grasp estimation for parallel grippers - a review [1] - On-going.
- Leveraging feature uncertainty in the pnp problem [2].
- Normalized objects [3].
- Berk Calli's YCB [4].
- NASA papers [5].
- Roadmap [6].

4 Progress

The following items are listed in the order of priority:

- VPQEKf: I finished working on data visualization and handling. Next, I will work on re-purposing QEKf section of the code. For the ROS implementation, I think I know what the issue may be. The error says, *hdf5.h* file is not found when building the Quest package. So, it might be resolved if I include the mentioned header file in the *package.xml* file.
Moreover, I read the first three chapters of [7]. It definitely helped.
- NBV Grasping Project: I did not work on this project this week. I will come back to this after I make more progress with VPQEKf.
- NASA MSI Fellowship: Need to read more NASA papers. – On pause.
- PyTorch Tutorials: Transfer learning.

- PE Survey (On pause): I think it might be that it is not worth the time to work on a pose estimation survey paper at this point. It is too much work for a journal paper. I have gained enough knowledge and skill to implement some new idea in regards to pose estimation. I can work on this after VPQEKF paper or even after NBV-Grasping.
- SD Team: No update.
- EE Autonobots: No update.

5 Immediate Plans - Summer 2021:

The following items are listed in the order of priority:

- UTARI: Dr. Gans' pose and velocity estimation paper.
- NBV-Grasping:
- Pose estimation: Survey paper.

6 Intermediate Goals - Fall 2021:

- Pose estimation: I must be finished with implementation, perhaps make some improvements, and should be working on a paper for ICRA or CVPR.
- Scene understanding and active learning: After pose estimation, I want to expand my research into scene understanding and active learning in the context of advanced manufacturing.
- ARIAC: Once I am up to speed, I will do the ARIAC workshops/tutorials and will talk to Jerry about possible contributions.

References

- [1] G. Du, K. Wang, S. Lian, and K. Zhao, “Vision-based robotic grasping from object localization, object pose estimation to grasp estimation for parallel grippers: a review,” *Artificial Intelligence Review*, pp. 1–58, 2020.
- [2] L. Ferraz Colomina, X. Binefa, and F. Moreno-Noguer, “Leveraging feature uncertainty in the pnp problem,” in *Proceedings of the BMVC 2014 British Machine Vision Conference*, pp. 1–13, 2014.
- [3] H. Wang, S. Sridhar, J. Huang, J. Valentin, S. Song, and L. J. Guibas, “Normalized object coordinate space for category-level 6d object pose and size estimation,” in *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, June 2019.
- [4] B. Calli, A. Singh, A. Walsman, S. Srinivasa, P. Abbeel, and A. M. Dollar, “The ycb object and model set: Towards common benchmarks for manipulation research,” in *2015 international conference on advanced robotics (ICAR)*, pp. 510–517, IEEE, 2015.
- [5] NASA, “Nasa technical reports server (ntrs).” <https://ntrs.nasa.gov/>, 2020. (Accessed on 05/07/2021).
- [6] USA-CRA, “roadmap-2020.pdf.” <https://cra.org/ccc/wp-content/uploads/sites/2/2020/10/roadmap-2020.pdf>, 2020. (Accessed on 04/30/2021).
- [7] D. M. Escrivá, P. Joshi, V. G. Mendonça, and R. Shilkrot, *Building Computer Vision Projects with OpenCV 4 and C++: Implement complex computer vision algorithms and explore deep learning and face detection*. Packt Publishing Ltd, 2019.