

Progress Report

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1 To Do

- PVNet implementation: Test and document, learn and rewrite.
- Implement pose estimation: Keypoint uncertainty, understand RANSAC.
- Look into methods of generating uncertainty data.
- Pose Estimation Server: On pause.
- Vision-based robotic grasping from object localization, object pose estimation to grasp estimation for parallel grippers - a review, [1]: Will read after PVNet implementation.
- Look into PyBullet for RL.
- Look into Facebook Flashlight C++ library, [2].
- Look into Nvidia Omniverse, [3].

2 Reading List

- [4]
- [5]
- [1]

3 Progress

The following items are listed in the order of priority:

- PyTorch Tutorials: I did more tutorials on custom neural network, CNN, image classification, and Tensorboard. Next, I will work on image segmentation and transfer learning tutorials.
- PVNet: I plan on recreating the algorithm with PyTorch and other available machine learning modules such as [6].
- NBV Grasping Project: I ended up converting STEP files to STL format and used SketchUp's web app to design a mount for RealSense L515. I sent the initial draft to Chris for review. I still need to add

final touches for zipties to be placed flush to the edge of the mount. Next, I will do ROS-UR5 tutorials to prepare for this project.

- NASA MSI Fellowship: I plan on writing a proposal on robotic arm manipulation for multiple applications. I can incorporate ideas from pose estimation with uncertainty to make it an attractive proposal. The topic is of interest to NASA per their 2020 technology taxonomy plan, [7]. In the document, they refer to grappling technologies capable of capturing natural and man-made free flying objects. Moreover, they seem to be interested in dexterous manipulation where a robot can handle various types of object while achieving compliant force control for safe operation near human operators and in deep-space environments. These topics are well inline with our work at Robotic Vision Lab and hold great potential commercial and social impacts as such areas are encouraged by NASA MSI grant program. There is a general call for proposals in MSI grant solicitation for robotic technologies inline with NASA missions. I will write an initial draft, after some review, I can reach out to find a technical advisor.
- UTARI: No new development.
- YCB Dataset [8]: Start with YCB data and look into Berk Calli's work.
- Normalized Objects [9]:
- Implement features from PoseCNN, DOPE, and BayesOD. - On pause.

4 Plans

The following items are listed in the order of priority:

- Pose Estimation in Simulation [10]: Use Nvidia Isaac SDK for in-simulation pose estimation training.
- Look into domain randomization and adaptation techniques.
- Project Alpe with Nolan: On pause for right now.
- UR5e: Finish ROS Industrial tutorials.

5 2021 Goals and Target Journals/Conferences

- Submit a paper on pose estimation with uncertainty to ICIRS.
- Get comfortable with TensorFlow and related Python modules.
- Keep writing.

References

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- [4] 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.
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- [8] 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.
- [9] 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.
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