Progress Report

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1 Specific Research Goals

- PVNet: Implement and improve.
- NBV-Grasping: Integrate PVNet pose estimation for experimentation with UR5.
- Pose estimation survey.

2 To Do

- MSI Fellowship: Read NASA papers. Develop proposal package.
- Setup ROC Client on UR5e.
- Implement a dense pose estimation algorithm with keypoint estimation: next.
- Look into Berk Calli's work [1].
- PVNet implementation: Paused.
- Normalized objects [2].
- Universal pose estimation.
- Look into methods of generating uncertainty data.
- Vision-based robotic grasping from object localization, object pose estimation to grasp estimation for parallel grippers - a review, [3]: Will read after PVNet implementation.

3 Reading List

- [4]
- [5]
- [6]
- [3]

4 Progress

The following items are listed in the order of priority:

- I did tutorials on PIL and Pickle.
- NASA MSI Fellowship: Next, I will read papers from NASA [7] and develop a proposal.
- PyTorch Tutorials: Next: Transfer learning.
- PVNet: Next: Use transfer learning and ResNet to train a model for semantic segmentation on YCB dataset.
- NBV Grasping Project: Next, I will install ROS client on UR5 and my lab station.
- UTARI: No new development.
- Implement features from PoseCNN, DOPE, and BayesOD. - On pause.

5 Immediate Plans - Summer 2021:

The following items are listed in the order of priority:

- Algorithms and Data Structures: I need to strengthen my algorithms and data structure implementation skills. I have noticed that my implementation could be a lot cleaner and could perhand process data more efficiently. I will focus on commonly used algorithms as I believe proficiency on this topic will decrease my average development time and make my code less prone to software bugs.
- Pose estimation: First, I will implement a simple pose estimation model and gradually will add feature extraction and other techniques for robust and fast pose estimation. I will have to learn how to extract features from ground truth data, i.g. label, bounding box, center, position, orientation and more. Some of these features are given but some need to calculated. So far, I have become familiar with Python development environment and 2D data manipulation. Next, I need to seek guidance on how to process 3D data sets. Coupled with what I have learned in CSE-6363 and PyTorch tutorials, I am confident I can

quickly develop a simple pose estimation model and improve it over the summer. I want to start writing a paper on this topic but it is difficult to set a timeline without a working implementation. Right after finals, I will resume working on this and read paper from CVPR and ICRA on the topic.

- NBV-Grasping: I will follow up with Chris and Joe and will try to assist and learn as much as I can. The goal is to write the paper by mid to end of the summer.
- UTARI: It depends on Dr. Gans' plan for the summer. Most likely, I will be working on phased array radar project.

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 manifacturing.
- ARIAC: Once I am up to speed, I will do the ARIAC workshops/tutorials and will talk to Jerry about possible contributions.

References

[1] 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.

[2] 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.

[3] 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.

[4] "roadmap-2020.pdf." `https://cra.org/ccc/wp-content/uploads/sites/2/2020/10/roadmap-2020.pdf`. (Accessed on 04/30/2021).

[5] 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.

[6] K. He, X. Zhang, S. Ren, and J. Sun, "Deep residual learning for image recognition. corr abs/1512.03385 (2015)," 2015.

[7] "Nasa technical reports server (ntrs)." `https://ntrs.nasa.gov/`. (Accessed on 05/07/2021).