Progress Report

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May 23, 2021

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1 Specific Research Goals

- Pose Estimation: Implement and improve.
- NBV-Grasping.
- Pose estimation survey.
- Universal pose estimation.

2 To Do

- Catch up with my reading list.
- OpenCV: Get comfortable using it.
- NBV-Grasping: Update URDF file, add camera. Write two inverse kinematic function for the gripper and the camera.
- PVNet implementation: Paused. Working on a simple pose estimation for now.
- MSI Fellowship: On pause. Deadline was too close. Will read NASA papers and write up something for next opportunity.
- Look into methods of generating uncertainty data.

3 Reading List

- VEst [1]
- NASA papers [2]
- Leveraging feature uncertainty in the pnp problem [3]
- Vision-based robotic grasping from object localization, object pose estimation to grasp estimation for parallel grippers - a review [4]
- Berk Calli's YCB [5]
- Normalized objects [6]
- Roadmap [7]

4 Progress

The following items are listed in the order of priority:

- Pose Estimation: I am working on extracting key points and features from YCB dataset. I also looked into camera calibration. I had some difficulties but Joe and Chris recommended using a ROS package so I will pursue that.
- OpenCV: I have dome some basic tutorials. I need to become intimate with this.
- QuEst [8]: In this paper, authers cleverly use Quaternion notation to derive and develop a 5-point pose estimation scheme that is more robust to noise. Quaternion notation increases dimensions of the problem but rather preserve more numerical precision in computation. This become apparent as QuEst performs better that SOTA for image sequences under noisy conditions. Moreover, this method computes translation and rotation independently which also eliminates error propagation from translation estimation to rotation estimation. For similar reasons, they based their algorithm on a 5-point or more pose estimation algorithm which is explained in more detail in [9].
- NASA MSI Fellowship: Next, I will read papers from NASA [2] and develop a proposal.
- PyTorch Tutorials: Transfer learning: I did this tutorial on PyTorch but I think I was too tired when I did that last week. I will do it again.
- PVNet: Next: Use transfer learning and ResNet to train a model for semantic segmentation on YCB dataset. – I was working on this when over write my boot section. I welcome problems. I was copying YCB dataset from my internal backup drive to my partion when I used rsync without a destination. Rsync is powerfull command that allows for files to be copied using the entire communication bus bandwidth. I started writing a shell script to automate the recovery procedure.
- NBV Grasping Project: Joe and I setup ROS Client on UR5e and were able to control it via my workstation. We had to downgrade to Ubuntu 18 because ROS Client driver uses ROS Melodic. After discussing this Chris, he recommended we move to Noetic and build the driver from source because ROS communication messages should

match between Melodic and Noetic. I will test this on my computer first then implement it on my workstation. I don't want to undo Joe's work without a robust solution.

- UTARI: I found the source code for QuEst. I will convert it from Matlab code to Python and will play with it.
- Implement features from PoseCNN, DOPE, and BayesOD. - On pause.

5 Immediate Plans - Summer 2021:

The following items are listed in the order of priority:

- 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.e. 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

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