Progress Report

Bardia Mojra

June 11, 2021

Robotic Vision Lab

The University of Texas at Arlington

1 Specific Research Goals

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

2 To Do

- Catch up on my reading list.
- Pose Estimation:
  - Read [1], up to chapter 5. Finished chapeter 3.
  - Key point feature extraction: ORB, SIFT, SURF.
  - Read VEst [2]. - Done
  - Implement QuEst in Python.
  - Survey: I need start working on this.
  - Evaluate various pose estimation methods: PnP, QuEst, and else.
  - PVNet implementation: Paused. Working on a simple pose estimation for now.
- 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.
  - UR5e in simulation: Joe might consider.
  - Learn and implement GraspIt package.
- MSI Fellowship: On pause.
- Look into methods of generating uncertainty data.

3 Reading List

- Vision-based robotic grasping from object localization, object pose estimation to grasp estimation for parallel grippers - a review [3] - On-going.
- NASA papers [4]
- Leveraging feature uncertainty in the pnp problem [5]
- Berk Calli's YCB [6]
- Normalized objects [7]
- Roadmap [8]

4 Progress

The following items are listed in the order of priority:

- Pose Estimation: On reading [3], I finished chapter 3 and will finish reading chapter 4 over the weekend. I plan on meeting Dr. Gans on Monday and discuss next step. He wants me to read QuEst and VEst papers again which will be helpful.
- QuEst [9]: Will read again.
- VEst [2]: Will read again.
- NASA MSI Fellowship: Need to read more NASA papers.
- PyTorch Tutorials: Transfer learning.
- NBV Grasping Project: With Chris' help, now I can open URDF file with ROS MoveIt package, configure it, and generate corresponding configuration files. Now, I am watching tutorials and reading the documentation on how to use MoveIt package. I need to add a link, gripper, depth sensor, and the surrounding environment such as the table to our URDF model. Next, I will generate inverse kinematic files for both Gripper and Sensor.
- PE Survey: Implement features from PoseCNN, DOPE, and BayesOD. - On pause.

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] Y. Ma, S. Soatto, J. Kosecká, and S. Sastry, *An Invitation to 3-D Vision: From Images to Geometric Models*. Interdisciplinary Applied Mathematics, Springer New York, 2012.

[2] A. P. Dani, N. Gans, and W. E. Dixon, "Position-based visual servo control of leader-follower formation using image-based relative pose and relative velocity estimation," in *2009 American Control Conference*, pp. 5271–5276, IEEE, 2009.

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

[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] 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.

[7] 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.

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

[9] K. Fathian, J.-P. Ramirez-Paredes, E. Doucette, J. Curtis, and N. Gans, "Quest: A quaternion-based approach for camera motion estimation from minimal feature points," *IEEE Robotics and Automation Letters*, vol. PP, pp. 1–1, 01 2018.