Progress Report

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1 To Do

- PVNet implementation: Debugging Cuda modules
- Implement pose estimation: Keypoint uncertainty, understand RANSAC.
- Look into methods of generating uncertainty data.
- Pose Estimation Servery: 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.

2 Reading List

- [2]
- [3]
- [1]

3 Progress

The following items are listed in the order of priority:

- Pose Estimation: Currently, I am working on debugging the four Cuda modules used in PVNet. Then, I will move on to dataset, testing, visualization and training modules, respectively.
- PVNet [4]: Initially, I installed Cuda 11.2, which is the latest version but it is not supported by PyTorch yet. So, I installed Cuda 11.1 and made sure I understood how to manage multiple versions of Cuda on one machine. It comes down to enabling (uncommenting) the corresponding Bash profile variable to define the target binary directory such as, `export CUDA_HOME=/usr/local/cuda-11.1`. This is more convenient than creating and removing symbolic links. I successfully tested Cuda, NVCC, and CuDNN and created a new Conda environemt with PyTorch 1.8, for PVNet-based development. The good thing about PyTorch 1.8 is that it works with Cuda 11.1 and that comes with Enhanced Compatibility. Cuda 11.1 and later version

source code can be compiled into dynamic libraries and later updated as such. Usually, this process involves the compiler generating a map file that allows for individual functions to be mapped to hexadecimal offsets to an array of function pointers with call-back return types. This allows for us to develop Cuda code agnostic of Cuda versions until NVidia makes major changes. We just have to be consistent with our own API. This is ideal for the production environment, and it was just released.

- YCB Dataset [5]: Start with YCB data and look into Berk Calli's work.
- Normalized Objects [6]:
- 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 [7]: 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

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

[4] S. Peng, Y. Liu, Q. Huang, X. Zhou, and H. Bao, "Pvnet: Pixel-wise voting network for 6dof pose estimation," in *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*, pp. 4561–4570, 2019.

[5] 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.

[6] 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.

[7] Nvidia, "Nvidia isaac sdk — nvidia developer." `https://developer.nvidia.com/Isaac-sdk`, 2021. (Accessed on 02/05/2021).