

Progress Report

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1 To Do

- Implement and play with PoseCNN and DOPE.
- Generate new data set using UE4.
- Start putting together literature reviews for Pose Estimation survey paper. - Done
- Read more papers on pose estimation.
- Look into transfer learning. Read [1].
- Look into domain randomization and adaptation.
- Reconstruct a pose estimation model to familiarize myself and then start modifying it.
- Read [2].
- Learn to use UE4.

2 Progress

Following items are listed in order of priority:

- Pose Estimation: I put together the literature reviews I have written for Pose Estimation related papers as a start for our paper. We just need to play with the data and given code base, add our contributions and test results (which I need to get on board with Jerry about) and revise accordingly. Moreover, I need to focus on learning the implementations which I had not had a chance to work on in the past two weeks. I need to finish implementing and dissecting PoseCNN and DOPE code bases, not sure when I will get the chance since I am already behind on lectures. With some basic understanding of what Lie Algebra is about, I still need to finish dissecting [1] for Pose Estimation work.
- Lie Algebra: It is a vector space V over a base field F along with bracket operation that satisfies bilinearity, antisymmetry, and the Jacobian Identity conditions. Considering the fact that robotic vision applications are process heavy, I find it immensely important to be

familiar with mathematical tools (such as Dynamic Primitive of Motor Control [3]) that enables us to encode important information into our models, whether it is actuator manipulation or dynamic scene understanding. [4] provides a good starting point on Lie Algebra. I am putting this new theory lead on pause till after Pose Estimation paper for this semester.

- Bayesian Scanning: I need to learn ORB-SLAM implementation, develop a new dynamic data structure for dynamic-resolution voxel space, develop 3D ORB feature detector and descriptor for 3D point-cloud KNN topology or for the contour. I need to familiarize myself much more with the mentioned theories and code based before I can fully mature the idea. I am sure there are technical difficulties that are still unknown-unknown to me.
- OCRTOC: I successfully setup Unreal Engine 4, [5]. Next, we need to look into Domain Randomization and other techniques for developing a data with diverse features and patterns.
- TensorFlow [6]: I am still working through chapter 2.
- MoreFusion [7]: Still need to write a literature review on this.
- Reading list: [8] and [9].
- Project Alpe with Nolan: We skipped this week's work session, we were both busy and Nolan had an important deadline.
- Quaternions:
- UR5e: I can work on putting together something presentable with UR5e but that might take some time.
- Fellowship:
- System Identification Presentation:

3 Plans

Following items are listed in order of priority:

- (On pause) Continue with ROS Industrial tutorials and documentation.

- (On pause) Resume Robotic Perception course as soon as possible.
- (On pause) Read Digital Image Processing by Gonzalez and Woods.

References

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- [3] “Dynamic primitives of motor behavior.” <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3735361/#R88>. (Accessed on 11/20/2020).
- [4] “L1_defsandexamples.pdf.” https://www.math.upenn.edu/~brweber/Courses/2012/Math650/Notes/L1_DefsandExamples.pdf. (Accessed on 11/20/2020).
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- [7] K. Wada, E. Sucar, S. James, D. Lenton, and A. J. Davison, “Morefusion: Multi-object reasoning for 6d pose estimation from volumetric fusion,” in *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*, pp. 14540–14549, 2020.
- [8] J. Lampinen and A. Vehtari, “Bayesian approach for neural networks—review and case studies,” *Neural networks*, vol. 14, no. 3, pp. 257–274, 2001.
- [9] R. Li, Z. Liu, and J. Tan, “A survey on 3d hand pose estimation: Cameras, methods, and datasets,” *Pattern Recognition*, vol. 93, pp. 251–272, 2019.