Progress Report

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July 18, 2022

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1 Specific Research Goals

- VPQEKF (—): Work on the paper.
- DLO Manipulation Dataset (ICRA - Sept. 1st)

2 To Do

- QEKF Paper - 30% extension (—): lack of direction
- Implementation (—):
  - Noise issue: noise cannot be modeled - revisit
  - SfM: RQuEst cannot find solution – under investigation
- DLO Manipulation: (ICRA - Sept. 1st)
  - Work on the paper everyday – up-coming
  - ICRA 2022 RL workshops: gym, stable-baseline3, and RL zoo – on-going
  - Setup digital twin reinforcement learing setup:
    - Unity Robotics extension setup – on-going.
    - Design dynamic DLO data collection system.
    - Build work cell. – on-going
    - Collect data and create a dataset.
    - Define evaluation metrics.
    - Create a high frequency RGBD dataset with UV-frames and open-loop input control actions as the ground truth.
  - Real-Time Preception
    - Deep learning methods for keypoint pose estimation in real-time.
    - Use UV dye dataset
    - Use PVNet-like approach for known-object pose estimation.
  - Learning DLO Dynamics and System Identification
    - List feasible approached for learing DLO dynamics
    - Model dynamics and deformity in a latent space
  - Real-Time Control

    - Time model inference, using auto-encoders generate the lowest dimensional representation for each object.
    - Use another GAN model for object deformity for each object.
    - Evaluate encoded representation for accuracy.
    - Used another GAN to explore other abstraced representations from individual encoded representation. In theory, we can create a low dimensionsal representation for multiple similar objects, given all individual low-dimensional representations. This is inspired by "fundamental principles first" approach which has universal applicability.

3 Progress

The following items are listed in the order of priority:

- XEst (RAL —): I printed out saved the outputs for 5-point algorithm [1] as well as QuEst as they estimate the essential matrix and quaternion solutions respective. We need to investigate why QuEst can not find a realizable solution. Although Quaternions are very robust to noise, they very sensitive to noise when estimating them from point correspondences. Coming up with a solution could take some time, so I put the project on pause for now.

- DLO Dataset (ICRA - Sept. 1st): I am working on finishing Unity tutorials today. My notes are attached. Tomorrow, Maicol and I will work Unity-ROS integration with UR5. Then, I will recreate the workcell.

- Maicol (REU): He will do what he wants, but I think he is smart enough not to do that. After your comment, I do not feel comfortable assigning tasks to Maicol. Moveover, I explained to him that this is your lab and you set the rules. If he is interested to volunteer/work at UTARI under my project, I will have to assume responsibility for him. That is what I told Dr. Gans that he agreed to him volunteering in Spring. I explained to him, I have no say on pay and Dr. Gans and Dr. Clements decide on that. I explained, his skillset, contribution and performance are the defining factors for a paid position. I explained to him that this is about mutual interested (him learning, and me getting more done with my research) and I offered him a much fairer deal than

when I received as an undergrad. I like him but I don't need his help, to be clear.

- PyTorch Tutorials: Transfer learning.
- Omniverse: Apply for access. – To-Do

References

[1] D. Nistér, "An efficient solution to the five-point relative pose problem," *IEEE transactions on pattern analysis and machine intelligence*, vol. 26, no. 6, pp. 756–770, 2004.