

# Progress Report

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September 10, 2022

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## 1 Specific Research Goals

- DLO Manipulation Dataset (ICRA - **Sept. 19th**) - on-going.
- VPQEKF (**—**): On pause. Asif may look into it.

## 2 To Do

- QEKF Paper (**On pause**):
  - Noise issue: noise cannot be modeled - DMD is a robust noise on high dimensional orthonormal time series and should be able to denoise QuEst solutions.
  - SfM: RQuEst cannot find solution - A potential solution is described briefly above.
- DLO Manipulation: (**ICRA - section out of date**)
  - Work on the paper everyday – up-coming
  - ICRA 2022 RL workshops: gym, stable-baseline3, and RL zoo – on-going
  - Setup digital twin reinforcement learning 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 – on hold
  - Learning DLO Dynamics and System Identification
    - \* List feasible approached for learning DLO dynamics – done
    - \* Model dynamics and deformity in a latent space

## 3 Progress

The following items are listed in the order of priority:

- DLO State Estimation (ICRA - Sept. 15th): I am working piDMD source code and trying to understand how I can use the **BCCB** configuration [1]. The provided examples are minimal and there are no instructions on how to use or even what it stands for. But fortunately I think I understand the underlying mathematics.  
They acknowledge some of their solutions are unstable and provide an *alternative solution to the upper-triangular piDMD problem*. They use *economy RQ decomposition of  $X$*  to write (84) and since *the first two terms of (84) are independent of  $\mathbf{A}$  and, by multiplicity of the Frobenius norm, have a non-negative sum*. On this basis, the upper-triangular Procrustes is phrased (85) and borrowing a multi-row-wise optimization computational technique from *Block Discrete Fourier Transform*, they write (88) as a direct solution for  $\mathbf{A}$ , given provided ***data is rank deficient***. Most often in real-world experiments, data collected is rank deficient due to noise and measurement imperfections. Moreover, they provide (89) as means to compute  $\mathbf{R}$  recursively backwards in order increase computational efficacy.
- Maicol (REU): He did well. DT is the future the industry has been dreaming of.
- DoD SMART (Dec 1st.): I started the application.
- XEst (RAL —): No update.
- PyTorch Tutorials: Transfer learning.

## References

- [1] P. J. Baddoo, B. Herrmann, B. J. McKeon, J. N. Kutz, and S. L. Brunton, “Physics-informed dynamic mode decomposition (pidmd),” *arXiv preprint arXiv:2112.04307*, 2021.