

Master's Thesis

# Liquid Pouring Using Supervised Learning

In this work, students will investigate the state-of-the-art methods in order to pour liquids with a service robot. We are eager to implement a Reinforcement Learning algorithm in order to infer liquids, estimated pouring volume, and different characteristics of the fluid dynamics.

In this project, we will utilize the Unity3D game engine and the simulator which is already developed for Kinova's Movo platform. Using the Unity3D ML-Agent and Nvidia's Flex physics engine we will investigate the state-of-the-art methods in particular in Deep Reinforcement Learning, in order to understand liquids by force interaction. We will also implement the learned model to the real robot and investigate the sim-to-real gap in the liquid pouring task.

## References:

1. Pan, Zherong, and Dinesh Manocha. "Feedback motion planning for liquid pouring using supervised learning." In *2017 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pp. 1252-1259. IEEE, 2017.
2. Zhu, Yuke, Ziyu Wang, Josh Merel, Andrei Rusu, Tom Erez, Serkan Cabi, Saran Tunyasuvunakool et al. "Reinforcement and imitation learning for diverse visuomotor skills." arXiv preprint arXiv:1802.09564 (2018).
3. Kennedy, Monroe, Karl Schmeckpeper, Dinesh Thakur, Chenfanfu Jiang, Vijay Kumar, and Kostas Daniilidis. "Autonomous precision pouring from unknown containers." *IEEE Robotics and Automation Letters* 4, no. 3 (2019): 2317-2324.
4. <http://akihikoy.net/info/res/lfdpour.php>
5. Guevara, Tatiana López, Nicholas K. Taylor, Michael U. Gutmann, Subramanian Ramamoorthy, and Kartic Subr. "Adaptable pouring: Teaching robots not to spill using fast but approximate fluid simulation." In *Proceedings of the Conference on Robot Learning (CoRL)*. 2017.
6. <https://github.com/qiang-ma/Learning-to-Pour-with-Reinforcement-Learning>
- 7.

## Prerequisites

- Strong C++ Background
- Strong Python Background
- Be familiar with Deep Reinforcement Learning methods like SAC or PPO

## Contact

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## Advisors

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