Karlsruhe Institute of Technology

Autonome Lernende Roboter (ALR)
Prof. Gerhard Neumann

Project Type

- ☑ Master Thesis
- ☐ Bachelor Thesis
- ☑ Research Project

Supervisors

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Difficulty

Algorithmic

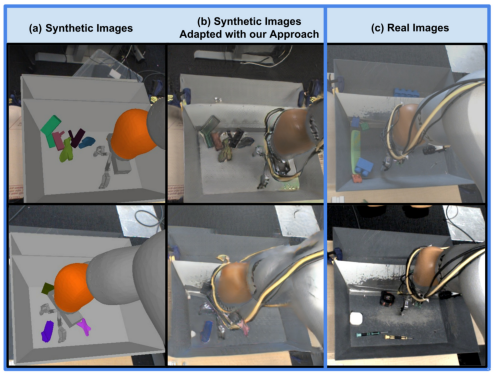
Math

Application

Grasp Adaptation for Robotic Manipulation

Description

In this project, the student is tasked to implement a robotic system that allows *sim2real* policy adaptation of grasps of objects in a heap. Closing the gap between simulation and reality would require data-efficient and scalable training in simulation and fast adaptation in a real scenario [1].



In this project, we will mainly follow a similar approach that has been studied in [3] where they use a simple meta-learning technique that pre-trains a joint policy on a very large real dataset. They use a base reinforcement learning algorithm (RL), called QT-Opt [4] to learn a joint policy across generated real scenarios. This approach is simply not data-efficient where it requires a massive amount of real data in order to enable transferring well across tasks. We will use a technique called Domain Randomization to generated a large set of simulated scenarios [3]. Both training on simulated data and adaptation on real data will be handled by QT-Opt.

Tasks

- Re-implementation: Implement an agnostic paralleled interface for domain randomization that will be used for different meta-learning or domain adaptation methods. This task will be based on the existing distributed and asynchronous QT-Opt implementation in the lab. We will build a distributed robotic simulation [2].
- Improvements: Propose improvements to achieve a more scalable and computationally efficient implementation.
- Benchmarking: The approach will be evaluated against the existing methods on different simulation adaptation scenarios.

References

[1] Konstantinos Bousmalis, Alex Irpan, Paul Wohlhart, Yunfei Bai, Matthew Kelcey, Mrinal Kalakrishnan, Laura Downs, Julian Ibarz, Peter Pastor, Kurt Konolige, et al. Using simulation and domain adaptation to improve efficiency of deep robotic grasping. In *ICRA*, pages 4243–4250. IEEE, 2018.

[2] Yevgen Chebotar, Ankur Handa, Viktor Makoviychuk, Miles Macklin, Jan Issac, Nathan Ratliff, and Dieter Fox. Closing the sim-to-real loop: Adapting simulation randomization with real world experience. In *ICRA*, pages 8973–8979. IEEE, 2019.

[3] Ryan Julian, Benjamin Swanson, Gaurav S Sukhatme, Sergey Levine, Chelsea Finn, and Karol Hausman. Efficient adaptation for end-to-end vision-based robotic manipulation. *arXiv preprint arXiv:2004.10190*, 2020.

[4] Dmitry Kalashnikov, Alex Irpan, Peter Pastor, Julian Ibarz, Alexander Herzog, Eric Jang, Deirdre Quillen, Ethan Holly, Mrinal Kalakrishnan, Vincent Vanhoucke, et al. Qt-opt: Scalable deep reinforcement learning for vision-based robotic manipulation. *arXiv preprint arXiv:1806.10293*, 2018.