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

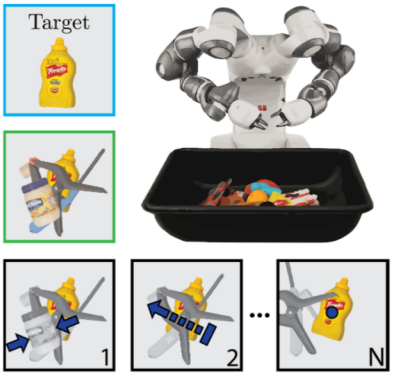
Math

Application

Grasping Specific Objects in a Heap

Description

In this project, we want to learn how to grasp a specific object out of a heap of cluttered objects. The target object might not be visible in the beginning and other objects might need to be removed or pushed away in order to make the target object visible and reachable.



We will base our work on an existing framework from the Stanford university called Mechanical Search [1] where they combine different algorithms for object identification and learning grasp points. For object identification, they use MaskRCNN [2], while DexNet [3] is used for selecting the grasp point. In this approach, the objects to be removed are currently selected via heuristics. We want to extend this approach with reinforcement learning such that the objects can be chosen more optimally. In order to do so, we will develop a object-centric policy representation that first decides which object to manipulate and subsequently how to manipulate it.

Tasks

The tasks in this project will involve:

- Reimplementation of Mechanical Search: The mechanical search approach needs to be reimplemented on our existing simulation platform. Existing software toolboxes such as MaskRCNN and Dexnet should be reused for this.
- Hierarchical Policy Design: We will implement a Hierarchical RL approach that first selects the object to manipulate and subsequently selects the manipulation parameters. The RL approach should first be tested on a simpler benchmark such as sorting 2 sort of cubes of objects.
- Policy Optimization: The hierarchical policy will be optimized by existing policy search methods such as TRPO [4].
- Benchmarking: The approach will be evaluated against the existing method on different complexities of the search task.

References

[1] Michael Danielczuk, Andrey Kurenkov, Ashwin Balakrishna, Matthew Matl, David Wang, Robert Martín-Martín, Animesh Garg, Silvio Savarese, and Ken Goldberg. Mechanical search: Multi-step retrieval of a target object occluded by clutter. In *Proc. IEEE Int. Conf. Robotics and Automation (ICRA)*, 2019.

[2] Kaiming He, Georgia Gkioxari, Piotr Dollár, and Ross B. Girshick. Mask R-CNN. *CoRR*, abs/1703.06870, 2017.

[3] Jeffrey Mahler, Jacky Liang, Sherdil Niyaz, Michael Laskey, Richard Doan, Xinyu Liu, Juan Aparicio Ojea, and Ken Goldberg. Dex-net 2.0: Deep learning to plan robust grasps with synthetic point clouds and analytic grasp metrics. *CoRR*, abs/1703.09312, 2017.

[4] John Schulman, Sergey Levine, Philipp Moritz, Michael I. Jordan, and Pieter Abbeel. Trust region policy optimization. *CoRR*, abs/1502.05477, 2015.