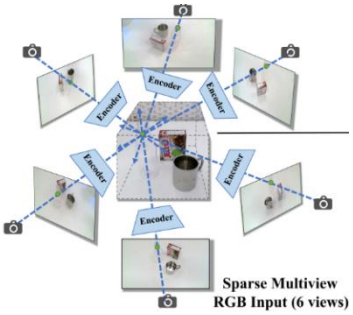
Karlsruher Institut für Technologie

Institut für Fördertechnik und Logistiksysteme

Master's Thesis (m/w/d)

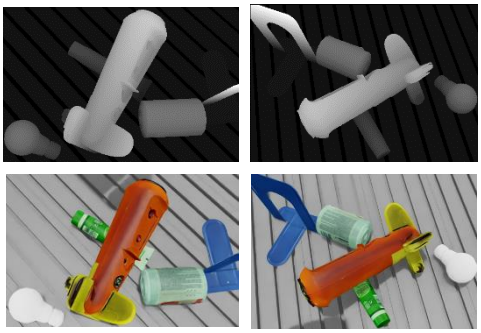
Uncertainty-aware Active Point Reconstruction for Robotic Grasping in Cluttered Scenarios

Problem formulation



Vision-based deep learning policies for robotic manipulation suffer from information bottlenecks given a single viewpoint, which becomes extremely severe under strong occlusions of objects. Some strategies leverage multi-view observations to alleviate the problem by point reconstruction explicitly (e.g. Neural Radiance Field (NeRF)) or implicitly in the feature field. Before that, an active agent can plan “where to see” or the so-called Next Best View (NBV) that aims to maximize the information gained from the other viewpoints. One of the directions is uncertainty quantification, which may guide your agent to observe the scene out of curiosity.

Task definition



In this thesis, the primary objective is to investigate methodologies for Next Best View (NBV) planning and how uncertainty quantification can be utilized to guide an agent's exploratory behavior for pointcloud-based deep policy for robotic grasping. We will deploy the developed policy on a physical robotic platform and validate its effectiveness in real-world scenarios, focusing on its ability to handle occlusions or dynamic environments. On the other hand, we may expect the network to be pre-trained by reconstruction tasks of novel viewpoints so it may enhance the scene understanding even if the data from a single viewpoint is given.

You shall offer

- Solid knowledge and experience in computer vision, deep learning.
- Coding skills in Python and Linux.
- Experience in simulation is a plus.

We will offer

- Powerful robot for experiments
- Powerful GPU server for training your AI.

References

- Dai, Qiyu, et al. "Graspnerf: Multiview-based 6-dof grasp detection for transparent and specular objects using generalizable nerf." 2023 IEEE International Conference on Robotics and Automation (ICRA). IEEE, 2023.
- NeU-NBV: Next Best View Planning Using Uncertainty Estimation in Image-Based Neural Rendering

Research area:
Computer Vision,
Deep Learning,
Imitation Learning

Requirement:
☒ Experimental
☒ Theoretical
☒ Practical
☒ Simulation
☐ Construction (CAD)

Studiengang:
☒ Mechanical Engineering
☒ Mechatronics
☒ Electronics
☒ Info-Tech
☐ Informationswirtschaft
☐ Wirtschaftsingenieurwesen

Begin: From now on

If you are interested, please send us an e-mail with your **curriculum vitae** and a current **transcript of records**.

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Please note that your data will be treated in accordance with the applicable data protection regulations as part of the application process.