



June 17, 2019

MASTER'S THESIS
for
Yuanjing Liu
Student ID 03703714, Degree EI

**Development of a System on Object Detection for Robotic Grasping
based on Mask R-CNN**

Problem description:

A new generation of compliant robotic manipulators (e.g. Franka Emika Panda) allows safe physical collaboration with humans. These robots lend themselves to applications such as service, rehabilitation or elderly care, where humans and robots are required to interact physically. To be helpful for the human these robots should be able to find and grasp objects in its surrounding.

There are plentiful approaches to this issue, mainly based on precise prior knowledge of the objects geometries and appearance [1]. In this work, we want to take a new approach, which should be more reliable and flexible facilitating the latest technologies of the areas of deep learning and computer vision. In detail Mask R-CNN [2] or Faster R-CNN [3] should be used for object detection and GPD [4] [5] for generic grasp position detection.

Tasks:

- Literature research and documentation.
- Enhance a data generator for creation and annotation of images.
- Improve Mask R-CNN to generate masks of better quality.
 - Add depth information to training dataset.
- Train neural networks to generate mask and get point clouds of objects based on object mask and depth camera.
- Combine GPD and evaluate the approach on the real system.

Bibliography:

- [1] Chavdar Papazov, Sami Haddadin, Sven Parusel, Kai Krieger, and Darius Burschka. Rigid 3d geometry matching for grasping of known objects in cluttered scenes. *The International Journal of Robotics Research*, 31(4):538–553, 2012.
- [2] Kaiming He, Georgia Gkioxari, Piotr Dollár, and Ross Girshick. Mask r-cnn. In *Proceedings of the IEEE international conference on computer vision*, pages 2961–2969, 2017.
- [3] Shaoqing Ren, Kaiming He, Ross Girshick, and Jian Sun. Faster r-cnn: Towards real-time object detection with region proposal networks. In *Advances in neural information processing systems*, pages 91–99, 2015.
- [4] Andreas ten Pas, Marcus Gualtieri, Kate Saenko, and Robert Platt. Grasp pose detection in point clouds. *The International Journal of Robotics Research*, 36(13-14):1455–1473, 2017.
- [5] Marcus Gualtieri, Andreas Ten Pas, Kate Saenko, and Robert Platt. High precision grasp pose detection in dense clutter. In *2016 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pages 598–605. IEEE, 2016.

Supervisor: M. Sc. Shile Li
Start: 01.08.2019
Intermediate Report: XX.11.2019
Delivery: XX.01.2020

(D. Lee)
Univ.-Professor