Transformer Networks for Grasp Generation on Unknown Objects

For many real-world applications, autonomous robots need to be able to handle unstructured environments with little to no available prior information. This complicates especially contact-rich tasks like the manipulation of objects in the scene based on visual perception. Many state-of-the-art approaches require object models or specific features for the interaction with the environment. However, this kind of prior information is either hard to obtain and, in some cases, simply does not exist. However, recently, the versatility of transformer networks has led to approaches that can cope with unseen objects in unstructured environments in the area of image and point cloud segmentation.

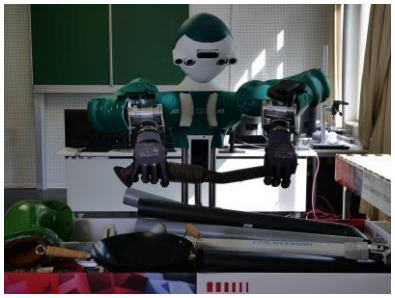

Fig. 1: The humanoid robot ARMAR-6 grasping unknown objects.

In this work, you will investigate how these approaches can be used for the generation of uni- and bimanual grasp candidates. To this end, a dataset of synthetic, random scenes with known objects has to be created that, in turn, can be used to train a deep neural network that predicts grasp candidates. Since these scenes are generated in simulation, it is easy to use existing methods for the generation of uni- and bimanual grasp candidates on known objects to be used as ground truth for the neural network. In the end, the method needs to be evaluated on the humanoid robot ARMAR-6 to be able to compare the results to state-of-the-art approaches.

Relevant research questions include:

- What kind of network architecture and visual modality results in the highest quality of grasp candidates?
- How can simulated scenes be used for the generation of uni- and bimanual grasp candidates along with visual ground truth data?
- How is the performance of the generated grasp candidates when executed on a real robot in unknown and unstructured environments?

This work will use the humanoid robot ARMAR-6 or ARMAR-DE, as well as several robotics and machine learning tools:

- ArmarX (C++, Python): armarx.humanoids.kit.edu
- Tensorflow or PyTorch (Python): tensorflow.org, pytorch.org

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