Bachelor Project Proposal: Learning grasp affordances of 3D objects using Deep Convolutional Neural Networks

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This research is aimed at learning to grasp 3D objects using Deep Convolutional Neural Networks (DCNN). In order to perform grasping tasks in a real world environment, a robot should be able to grasp a vast number of objects with a wide variety of shapes and sizes. Deep learning approaches have made huge advancements in generating grasp affordances of unknown objects, and could therefore be a viable solution to this challenge. Hence, the importance of this project lies in its contribution towards identifying the effectiveness of DCNN as a prospective solution. More specifically, this project will evaluate the performance of the Generative Grasp Convolutional Neural Network (GGCNN) architecture proposed by Morrison et al. [2]. Therefore, the main research question of this project is: *(i) How effective can Deep Convolutional Neural Networks be for learning the grasp affordances of 3D objects?*

The requirements of the relevant Bachelor project include a literature review within the discipline, the implementation of relevant code, experimentation with benchmarks as well as writing a thesis. We mainly use C++ based ROS as the main programming language. For the deep learning parts, we will use Keras with tensorflow backend. Python will be used to develop a simulated environment. Through this project, we assume images are taken under various lighting conditions and each image contains the top view of a 3D object in a RGB-D format.

To give a brief overview of the stages that make up the research, we begin by developing a simulated environment using PyBullet, such that a robotic gripper can execute grasping tasks. Next, a data set is developed using the Cornell and/or the Jacquard [1] dataset for training and validating the GGCNN. The performance of the GGCNN will then be tested in the simulated environment. The experimental results will be evaluated, and subsequently compared against state of the art models for grasp synthesis. If possible, the performance of the GCCNN will be tested in a real world experiment.

References

[1] E. Dellandrea A. Depierre and L. Chen. "Jacquard: A Large Scale Dataset for Robotic Grasp Detection". In: *IEEE International Conference on Intelligent Robots and Systems* (2018).

[2] Douglas Morrison, Peter Corke, and Jürgen Leitner. "Closing the Loop for Robotic Grasping: A Real-time, Generative Grasp Synthesis Approach". In: *Robotics: Science and Systems (RSS)* (2018).

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