

IDP theme: Predict the best sets of grasping points for incoming object

This project is the combination of Machine Learning in Informatics and Robotics in Electrical Engineering.

In Machine Learning area, an Artificial Neural Network (so-called Neural Network) is used to predict which points on the surface of the targeted object should robot's end-effector touch, making robot's hand hold the object firmly. An Artificial Neural Network (ANN) is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. The key element of this paradigm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurones) working in unison to solve specific problems. ANNs, like people, learn by example. An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process. Learning in biological systems involves adjustments to the synaptic connections that exist between the neurones. This is true of ANNs as well. Neural networks, with their remarkable ability to derive meaning from complicated or imprecise data, can be used to extract patterns and detect trends that are too complex to be noticed by either humans or other computer techniques. A trained neural network can be thought of as an "expert" in the category of information it has been given to analyse. This expert can then be used to provide projections given new situations of interest and answer "what if" questions. Specifically, in this project, input data is firstly created by collecting grasping points for many different objects. Then, this data is fed into a neural network. After being trained, this network could be used to predict the points robot's end-effector should approach so as to grasp any new object. It should be noted that for any incoming object, there could be more than one set of possible grasping point, and the network is also responsible for making decision that among a number of sets of grasping point, which one is the best.

In Robotics area, basic problems such as transformation, inverse manipulator kinematics and trajectory generation are analysed and solved by the simulation software "OpenRave". OpenRAVE provides an environment for testing, developing, and deploying motion planning algorithms in real-world robotics applications. The main focus is on simulation and analysis of kinematic and geometric information related to motion planning. OpenRAVE's stand-alone nature allows it to be easily integrated into existing robotics systems. It provides many command line tools to work with robots and planners, and the run-time core is small enough to be used

inside controllers and bigger frameworks. An important target application is industrial robotics automation. OpenRave also provides a plenty of examples for different particular problems such as moving, grasping or navigation. And for this particular project, examples about collision and grasping are very useful, providing elementary stuff for resolving the problem.

In order to fully understand the mechanism that Openrave used to detect and avoid collision with untargeted object, as well as collision with targeted object before grasping it. I found out that the lecture “Dynamic Human Robot Interaction” which will take place in this winter semester is really useful. The part “Collision Detection and Avoidance” is the relevant part to this project.

About this Interdisciplinary Project, I will work with Openrave on Ubuntu environment, using Pycharm as IDE. Through powerful potentials of Openrave, the task for creating input data become much easier, since it provide high-level interface functions.