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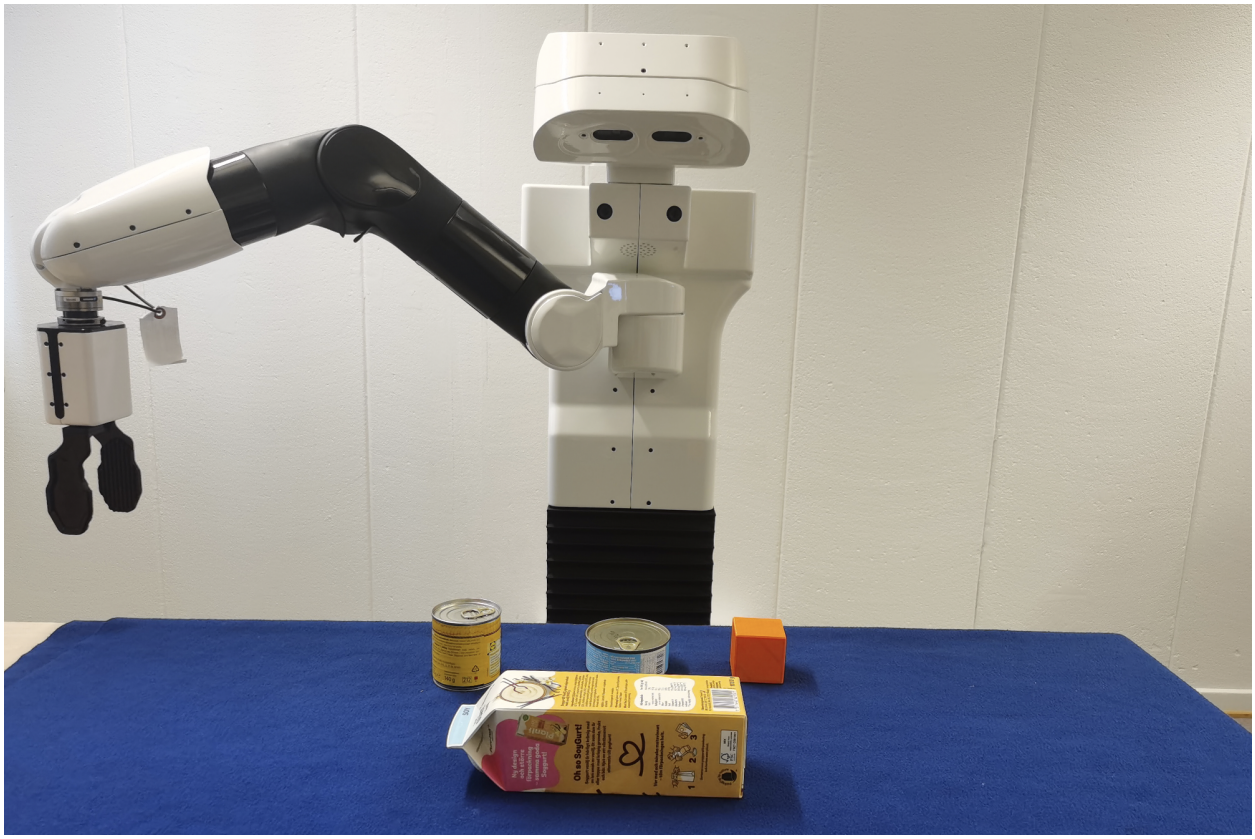

# An Analysis of Manipulation Strategies of Different Objects Applied to the TIAGo Robot

Master's thesis in Master Programme in Systems, Control and Mechatronics

LEI DENG
HONG TAO

DEPARTMENT OF ELECTRICAL ENGINEERING
CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2022
www.chalmers.se

Master's thesis 2022

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LEI DENG
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Department of Electrical Engineering
*Systems and Control*
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Supervisor: Karinne Ramirez-Amaro, Electrical Engineering
Examiner: Karinne Ramirez-Amaro, Electrical Engineering

Master's Thesis 2022
Department of Electrical Engineering
Division of Systems and Control
Chalmers University of Technology
SE-412 96 Gothenburg
Telephone +46 31 772 1000

Cover: The TIAGo robot is preparing to manipulate the different objects on the desk.

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LEI DENG
HONG TAO
Department of Electrical Engineering
Chalmers University of Technology

# Abstract

Nowadays, home service robots have become a research hot-spot in the field of robotics, and delivering small objects is one of the most important research tasks of home service robots. Grasping is an essential component of robotic manipulation focusing on obtaining complete control over the motion of an object. The grasping task is divided into object detection, grasp planning, and grasp control.

This thesis aims to analyze the manipulation strategies of different objects applied to the TIAGo robot. Firstly, we implement object detection using different algorithms and strategies, including object color detection with OpenCV, point cloud library clustering method, and unseen object clustering method for object segmentation. Secondly, we realize and analyze robotic grasp planning. Thirdly, we implement robot motion control using different strategies. Consequently, we integrate the implementation of the whole manipulation strategies and realize the complete grasping task of different objects on the TIAGo robot.

In order to make the strategy more general to adapt to a variety of different objects, we finally adopted the UnseenObjectClustering method to cluster objects. The Contact-GraspNet grasp planning algorithm we used can generate grasps for most objects in the ACRONYM dataset, and TIAGo can also successfully manipulate the objects. Due to the accuracy limitations of the TIAGo robot, the success rate of grasping is about 80%, and more calibration needs to be studied in the future.

Keywords: Manipulation strategy, Object detection, Robotic grasp planning, Motion planning

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