Self-Introduction

Presentation

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Personal Information

ZHANG Hanlin (Raymond)

Senior Student at Maynooth University and Fuzhou University (joint education)

- **Major: Robotics**
- **Research Interest: Computer Vision, Trajectory Planning and Robotic Arm**
- **Other Hobby: Badminton, Running and Listening to Music**

For Robot Manipulation and Control, I did:

Course Project: Real-Time Image Analysis for Autonomous Vehicles

Aim: Design real-time image processing strategies to enhance object detection, classification and tracking within autonomous driving systems.

Research Key Word: YOLOv7 Network, Loss Function, Activation Function, Attention Mechanism.

A dataset is built about pedestrian and vehicle as shown in Fig 1.

Fig 1: Part of the dataset on pedestrians and vehicles.

For Robot Manipulation and Control, I did:

Lab Program: Rotated Object Detection Based on Improved Hough Transform

Aim: YOLO network utilizes sliding window method to detect vertical objects, which performs low detection precision for objects with rotation angle. We proposal a method to improve the detection accuracy to recognize these tilted objects.

Research Key Word: YOLO Network, Household Items, Rotated Object Detection, Hough Transform

Some angle detection results are displayed in Fig 2.

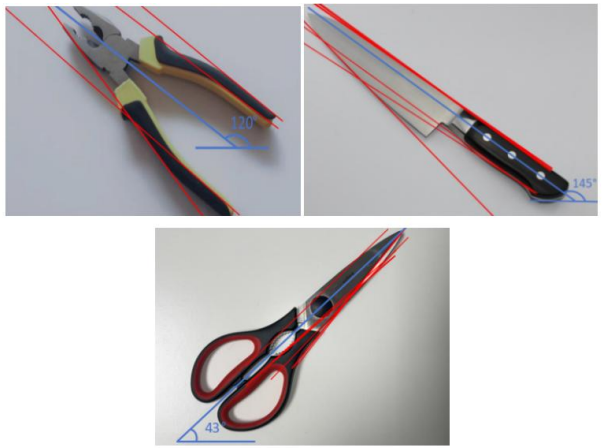

Fig 2: Angle detection results of tilted object using improved hough transform.

For Robot Manipulation and Control, I did:

Lab Program: Optimal Grasping Gesture Detection of 3D Objects in Unstructured Environment

Aim: Due to characteristics of different objects like shapes, placing posture and materials, different types of object grasping prediction will exist for the candidate items. It is required to detect and predict the potential grasps accurately and rapidly.

Meanwhile, we aim to find friendly human-computer interaction and detect the optimal grasping posture that aligns with human interaction habits.

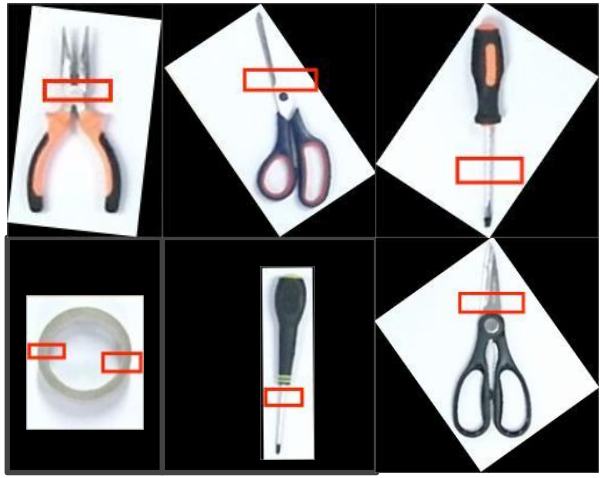

Fig 3: Optimal grasping gesture detection with friendly human-computer interaction

For Robot Manipulation and Control, I did:

Lab Program: Optimal Grasping Gesture Detection of 3D Objects in Unstructured Environment

Main Contribution:

1. Construct dataset about optimal grasping gesture.

2. Use improved YOLO network and Minimum Bounding Rectangle method to identify tilted grasping box.

3. Program robot arms to grasp objects according to input location.

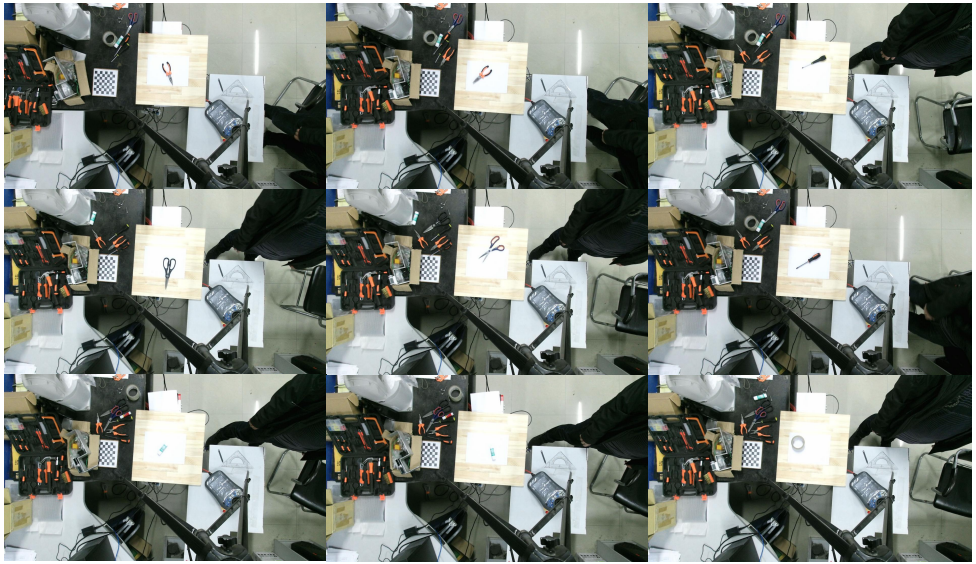

Fig 4: Part of database about household objects: plier, scissor, screwdriver, glue stick and so on.

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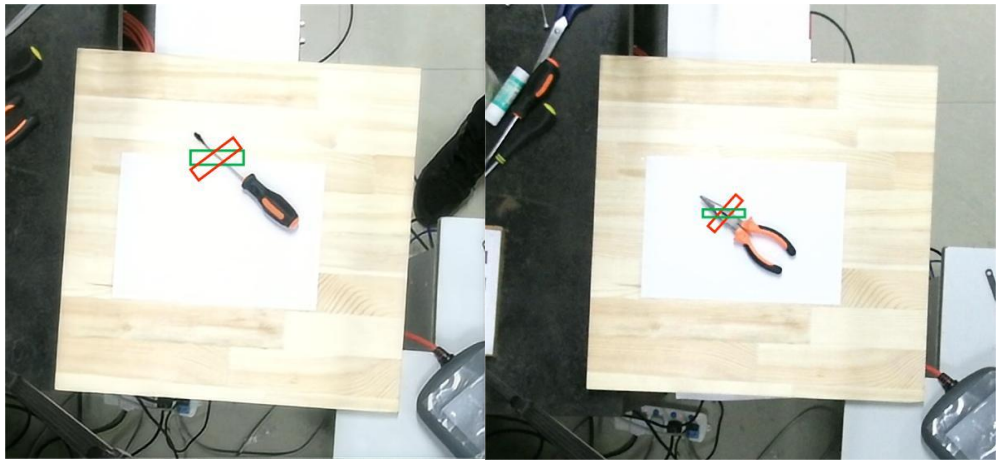

Fig 5: Grasping prediction based on normal YOLOv7(green box) and improved YOLOv7 that we propose(red box).

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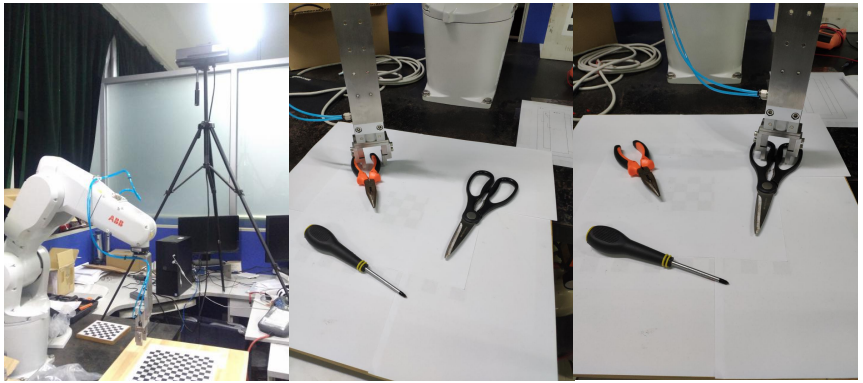


Fig 6: ABB IRB1200 robot arm and robot grasping experiment

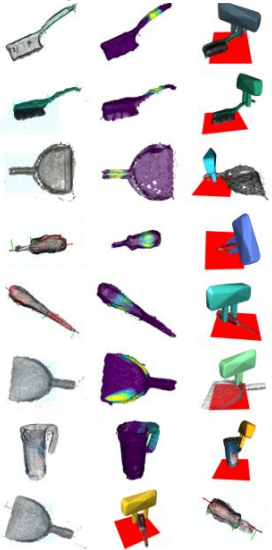
Ultimate Goal:

1. To develop a perception system based on **machine vision** that enables robot to achieve real-time, accurate and rapid detection and prediction in complex environments.

2. To design a highly efficient and stable robot manipulation by integrating with **control strategy** and **path planning algorithms** to deal with challenge in dynamic motion.

For Robot Manipulation and Control, I plan to:

1. Introduce point cloud or keypoint presentation of the target object, and identify the optimal grasping gesture that aligns with human interaction habits.



Key Word: Keypoint Presentation

Fig 7: Picture from Mark Robson and Mohan Sridharan. A Keypoint-based Object Representation for Generating Task-specific Grasps. In the IEEE International Conference on Automation Science and Engineering (CASE), Mexico City, Mexico, August 20-24, 2022.

For Robot Manipulation and Control, I plan to:

2. Design a variable impedance controller that will be used to buffer the sudden changes in force as smooth transitions, in case of deformation and destruction when grasp and release.

Key Word: Changing-Contact Robot Manipulation

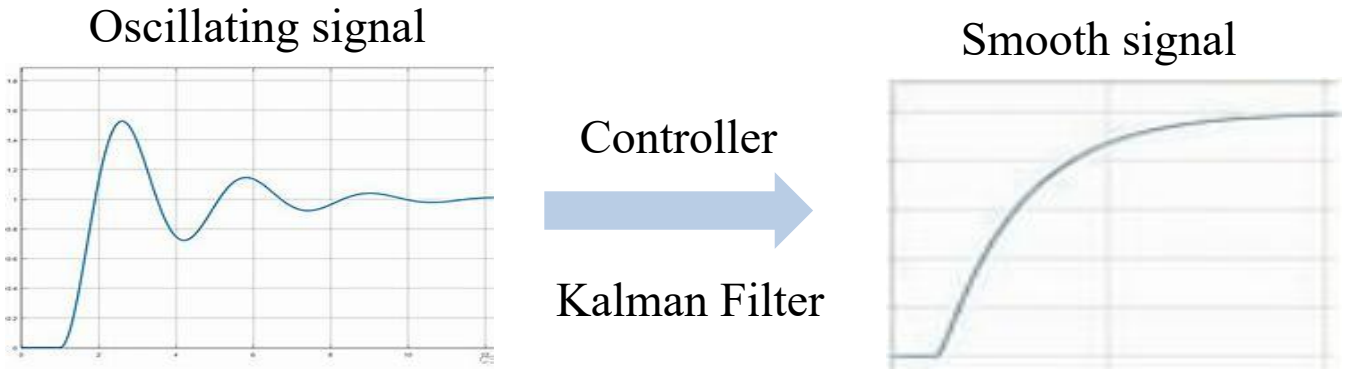
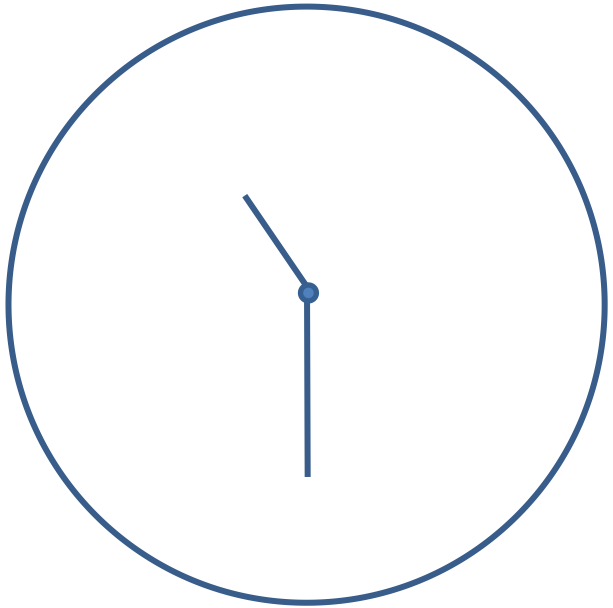


Fig 8: The process to buffer the sudden changes in force.

Thank you!



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