Couse Project Description

CS 6301 Special Topics: Introduction to Robot Manipulation and Navigation
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Course Project

• Team Project (45%)
  • 2 - 3 students for a project

• Project proposal (5%)

• Project mid-term report (10%)

• Project presentation (15%)

• Project final report (15%)
Course Project Tracks

• Research-oriented
  • Proposal a new idea in robotics that has not been explored before
  • Implement the new idea and conduct experiments to verify it

• Application-oriented
  • Apply an existing algorithm or method to a new problem or a new application
  • E.g., if a method is proposed for domain A, explore applying it to a different domain

• Implementation-oriented
  • Select an existing algorithm or method, implement it and conduct experiments to verify the implementation
  • Cannot just use open-source code and run experiments with it
Mandatory Requirements

• The project needs to have a robot

• The project needs to have robot manipulation
Topic: Model-based Grasping
Self-supervised 6D Object Pose Estimation for Robot Manipulation. Deng et al., ICRA’20

Topic: Model-based Grasping Planning

Graspit! [https://graspit-simulator.github.io/](https://graspit-simulator.github.io/)
Topic: Model-based Grasping Planning
Topic: Model-based Motion Planning

Moveit https://moveit.ros.org/
Topic: Learning-based Top-Down Grasping


https://zxp-s-works.github.io/equivariant_grasp_site/
6-DOF GraspNet: Variational Grasp Generation for Object Manipulation. Mousavian et al., ICCV’19
Goal-Auxiliary Actor-Critic for 6D Robotic Grasping with Point Clouds. Wang et al., CoRL’21
https://sites.google.com/view/gaddpg
Topic: Articulated Object Manipulation

https://hyperplane-lab.github.io/vat-mart/

VAT-Mart: Learning Visual Action Trajectory Proposals for Manipulating 3D ARTiculated Objects, Wu et al., ICLR’22
https://arxiv.org/abs/2104.12149
Topic: Mobile Manipulation

https://www.youtube.com/watch?v=ZQknooga8A0
Topic: Mobile Manipulation

• TidyBot

https://tidybot.cs.princeton.edu/
Topic: Language-guided Manipulation

https://say-can.github.io/
Goal–Auxiliary Actor–Critic for 6D Robotic Grasping with Point Clouds
Lirui Wang, Yu Xiang, Wei Yang, Arsalan Mousavian and Dieter Fox
In Conference on Robot Learning (CoRL), 2021.
Simulator: Gazebo

https://gazebosim.org/home

- Integrated with ROS
Simulator: PyBullet

- Python interface

https://pybullet.org/wordpress/
Simulator: NVIDIA Isaac Gym

- GPU acceleration
- Parallelization of thousands of environments

Simulation Environment: iGibson

Fully-Interactive and Photorealistic

15 scenes annotated from real-world homes

Support 12000+ scenes from CubiCasa5K and 3D-Front

Physical Interaction with Articulated Objects

More than 500 object models

Sourced from open source datasets and cleaned up

Articulated objects can be operated by agents

https://svl.stanford.edu/igibson/
Simulation Environment: ManipulaTHOR

https://ai2thor.allenai.org/manipulathor
Simulation Environment: Habitat-sim

https://github.com/facebookresearch/habitat-sim
Simulation Environment: SAPIEN

https://sapien.ucsd.edu/
Simulation Environment: BulletArm

https://arxiv.org/abs/2205.14292
Propose Your Projects

• Which topic to work on?
  • Grasping? Language-guided Manipulation? Mobile Manipulation?

• What specific problem to work on within the chosen topic?

• Which simulation environment to use?

• Which track is your project?
  • Research-oriented? Application-oriented? Implementation-oriented?
Discussion