

CHAO CAO

<http://www.caochao.me> | ccaol@andrew.cmu.edu | (412)616-6870

Education

Carnegie Mellon University (CMU)

Ph.D. in Robotics

Advisors: Ji Zhang, Howie Choset

Pittsburgh, U.S.

August 2020 - Present

Carnegie Mellon University (CMU)

Master of Science in Robotics

Advisors: Matt Travers, Howie Choset, John Dolan

Pittsburgh, U.S.

September 2017 - May 2019

The University of Hong Kong (HKU)

Bachelor of Engineering in Computer Science

Advisors: Jia Pan, Wenping Wang

Hong Kong SAR

September 2013 - June 2017

Selected Publications

- **Chao Cao**, Hongbiao Zhu, Zhongqiang Ren, Howie Choset, Ji Zhang. "*Representation Granularity Enables Time-Efficient Autonomous Exploration in Large, Complex Worlds*". Science Robotics, 2023.
- **Chao Cao**, Hongbiao Zhu, Fan Yang, Yukun Xia, Howie Choset, Jean Oh, and Ji Zhang. "*Autonomous Exploration Development Environment and the Planning Algorithms*". IEEE International Conference on Robotics and Automation (ICRA), 2022
- F. Yang, **Chao Cao**, H. Zhu, J. Oh, and J. Zhang. FAR Planner: Fast, Attemptable Route Planner using Dynamic Visibility Update. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS), 2022. **Best Student Paper Award**
- **Chao Cao**, Hongbiao Zhu, Howie Choset, and Ji Zhang. "*TARE: A Hierarchical Framework for Efficiently Exploring Complex 3D Environments*". Robotics: Science and Systems Conference (RSS), 2021. **Best Paper Award and Best System Paper Award**
- **Chao Cao**, Ji Zhang, Matt Travers, Howie Choset, "*Hierarchical Coverage Path Planning in Complex 3D Environments*", IEEE International Conference on Robotics and Automation (ICRA), 2020
- **Chao Cao**, Peter Trautman, Soshi Iba, "*Dynamic Channel: A Planning Framework for Crowd Navigation*", IEEE International Conference on Robotics and Automation (ICRA), 2019
- **Chao Cao**, Weiwei Wan, Jia Pan, Kensuke Harada, "*An Empirical Comparison of the Effect of Different Supports in Sequential Robotic Manipulation*", IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2016
- **Chao Cao**, Weiwei Wan, Jia Pan, Kensuke Harada, "*Analyzing the Utility of a Support Pin in Sequential Robotic Manipulation*", IEEE International Conference on Robotics and Automation (ICRA), 2016

Research & Work Experience

Carnegie Mellon University

Robotics Institute, Software/Hardware Engineer

Supervisors: Matt Travers, Sebastian Scherer

- Served as the planning team lead for the DARPA Subterranean Challenge

Pittsburgh, PA, USA

June 2019 - August 2020

Honda Research Institute USA

Robotics Intelligence Group, Research Intern

Supervisors: Peter Trautman, Soshi Iba

- *Developed a topology based planning algorithm for mobile robot navigation in crowded human environments*

Mountain View, CA, USA

May 2018 - August 2018

National Institute of Advanced Industrial Science and Technology (AIST)

Manipulation Group, Research Intern

Supervisors: Kensuke Harada and Weiwei Wan

- Developed a framework for robotic manipulators to perform object re-orientation tasks by using external dexterity

Tsukuba, Japan

July 2015 - August 2015

The University of Hong Kong

HKU Advanced Robotics Initiative, Research Assistant

Supervisors: Wyatt Newman, Jia Pan and Robert C. Roberts

- Developed an algorithm for point-cloud segmentation and clustering
- Created a Human-Robot Interface to promote safe interactions with the Atlas humanoid robot

Hong Kong SAR

July 2014 - June 2017

Robotics Challenges

- DARPA Subterranean Challenge** - Member of Team CMU/OSU September 2018 - September 2021
- Developed planning algorithms for both ground and aerial robots to autonomously explore and search in subterranean environments
 - Developed a multimodal wireless communication system combining WiFi and 900Mhz for field operation
 - Won the 1st place in the Tunnel Circuit Event, 2 nd place in the Urban Circuit and 4 th place in the Final event
- DJI Developer Challenge** - Member of Team HKU March 2016 - August 2016
- Developed a vision-servoing algorithm for a quadcopter to automatically track and land on a moving vehicle
- DARPA Robotics Challenge** - Member of Team HKU July 2014 - June 2015
- Developed a point-cloud based pose estimation algorithm for tabletop object manipulation
- Amazon Picking Challenge** - Member of Team HKU/Dorabot Inc. November 2014 - May 2015
- Developed motion planning softwares for the pick-and-place manipulation task
 - Performed manipulability and reachability analysis of the UR5 robot for optimising the workspace configuration
- ACM Collegiate Programming Contest (Hong Kong)** June 2015
- Ranked 10th among 150 teams from Hong Kong and Macau
- Asia-Pacific Robot Contest (ABU Robocon)** - Member of Team HKU November 2013 - June 2014
- Embedded system programming and PCB design

Projects

- Deep-learned Pedestrian Avoidance Policy for Robot Navigation** September 2016 - June 2017
- Final year project at HKU, supported by Hong Kong Innovation and Technology Fund
 - Golden Award of 2017 Pan-Pearl River Delta Region Universities IT Project Competition
 - Third Prize of HK X-Tech Final Year Project Supporting Scheme
 - First Runner-up of 2017 Pan-Pearl River Delta Region Universities IT Project Competition (Hong Kong Region)
 - Champion of HKU Computer Science Final Year Project Competition 2016-17
 - More at <https://dodgebot.github.io/>
- Qiubot** August 2016 - May 2017
- Designed and built a robot that can balance on a ball. More at <http://www.qiubot.com>

Awards & Honours

- IROS Best Student Paper Award (2022)**
Carnegie Mellon University Presidential Fellowship (2021)
Most Sectors Explored Award in DARPA Subterranean Challenge (2021)
RSS Best Paper Award and Best System Paper Award (2021)
ICRA Travel Grant, IEEE Robotics and Automation Society (2019)
IROS Travel Grant, IEEE Robotics and Automation Society (2016)
Undergraduate Research Fellowship, HKU (2016-2017)
Chui's Student Excellence Scheme - Ho Wing Hing Talent Fund, HKU (2016)
The Arthur and Louise May Memorial Fund Scholarship, HKU (2013-2015)
Chiap Hua Cheng's Foundation Scholarships, HKU (2014)
Entrance Scholarships in Electrical and Electronic Engineering, HKU (2014)
Dean's Honors List, HKU (2013-2017)

Service

Reviewer:

- IEEE Transactions on Robotics (TRO), 2021-22
Journal of Field Robotics (JFR), 2021
International Journal of Robotics Research (IJRR), 2021
Autonomous Robots, 2020
IEEE Intl. Conf. on Robotics and Automation (ICRA), 2019-22
IEEE Robotics and Automation Letters (RAL), 2019-20
IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS), 2016, 2020-21
Workshop on the Algorithmic Foundations of Robotics (WAFR), 2020