

# CHAO CAO

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## 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, 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
- **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
- Chor Hei Ernest Cheung, **Chao Cao**, Jia Pan, "*Multi-Contour Initial Pose Estimation for 3D Registration*", IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2015

## 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

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**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

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**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 Price 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

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**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

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### 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