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Kuanqi Cai

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About me:
I have received a Ph.D. offer from the Technical University of Munich with the Marie Skłodowska-Curie Actions Scholarship in 2023, under the supervision of Prof. Sami Haddadin and Dr. Luis Figueredo. I received my B.S. degree from Hainan University in 2018 and my M.E. degree from the Harbin Institute of Technology in 2021, under the supervision of Prof. Max Q.-H. Meng. During my graduate studies, I worked as a Robotics Student Fellow at ETH Zürich in the Autonomous Systems Lab, under the supervision of Prof. Siegwart, Roland, Dr. Chung, Jen Jen, and Dr. Dugas, Daniel, in 2021. Additionally, I worked as a research assistant in the Robotics, Perception, and AI Lab at the Chinese University of Hong Kong and as a visiting student in the Shenzhen Key Laboratory of Robotics, Perception, and Intelligence at the Southern University of Science and Technology. In 2022, I worked at the Chinese University of Hong Kong (Shenzhen Research Institute).
My research interests include service robotics, motion planning, and mechanical design.

EDUCATION AND TRAINING

2023 – CURRENT
PH.D. STUDENT & MARIE SKŁODOWSKA-CURIE ACTIONS EARLY STAGE RESEARCHER (ESR) Technical University of Munich (TUM)

Member of Munich Institute of Robotics and Machine Intelligence (Supervisor: Prof. Sami Haddadin, Dr. Luis Figueredo)
Marie Skłodowska-Curie Actions Scholarship (Doctoral Training Network)

07/2021 – 09/2021
ROBOTICS STUDENT FELLOW ETH Zürich (ETHZ)

Member of Autonomous Systems Lab (Supervisor: Prof. Siegwart Roland, Dr. Chung Jen Jen, Dr. Dugas, Daniel)
ETH Robotics Student Fellowship, ETH Zürich, (Only 9 students from around the world were accepted)

03/2019 – 02/2023
RESEARCH ASSISTANT The Chinese University of Hong Kong (CUHK)

Advisor: Prof. Max Q.-H. Meng
Research Assistant in the Shenzhen Research Institute (SZRI) *Jul. 2021 - Feb. 2023*
Research Assistant at the Robotics, Perception and AI Lab *Mar. 2019 - Oct. 2020*
Visiting Student Researcher in the Electronic Engineering Department *Mar. 2018 - Sep. 2018*

09/2018 – 09/2021

MASTERS IN MECHANICAL ENGINEERING - POSTGRADUATE RECOMMENDATION Harbin Institute of Technology (HIT)

GPA: 3.20/4.00 | Ranking: 13/93 | Member of Robotics and Perception Lab (Advisor: Prof. Max Q.-H. Meng)
Obtained the postgraduate recommendation qualification of the Chinese Academy of Sciences (SIA)
Research Interests: Motion and Path Planning, Human-Robot Interaction | Outstanding Graduate

11/2020 – 12/2022

VISITING STUDENT IN THE SHENZHEN KEY LABORATORY OF ROBOTICS PERCEPTION AND INTELLIGENCE Southern University of Science and Technology (SUSTech)

Laboratory director: Prof. Max Q.-H. Meng

09/2014 – 06/2018

BACHELOR OF ENGINEERING IN TRAFFIC ENGINEERING (AUTOMOBILE APPLICATION ENGINEERING) Hainan University (HNU)

GPA: 3.87/4.00 (Top 1%) | Member of "ZhiYuan" class (Top 3%) | Graduated with Outstanding Honor
Research Interests: Mechanical Design, Robotics, Motion and Path Planning

ADDITIONAL INFORMATION

PUBLICATIONS

Sampling based Robot Path Planner in Highly Dynamic and Crowded Pedestrian Flow

IEEE Transactions on Intelligent Transportation Systems, (Submit)
Kuanqi Cai, Weinan Chen, Daniel Dugas, Roland Siegwart, Jen Jen Chung.

Curiosity-based Robot Navigation under Uncertainty in Crowded Environments

2021 IEEE International Conference on Robotics and Automation (ICRA) Workshop on Social Intelligence in Humans and Robots (Accept)
IEEE Robotics and Automation Letters (RA-L) with IROS 2023
Kuanqi Cai, Weinan Chen, Chaoqun Wang, Shuang Song, Max Q.-H. Meng.

Link https://youtu.be/o32I_c1IxH8

FlowBot: Flow-based Modeling for Robot Navigation

2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
Daniel Dugas, **Kuanqi Cai**, Olov Andersson, Nicholas Robert Jonathon Lawrance, Roland Siegwart, Jen Jen Chung.

Human-aware Motion Planning with Improved Virtual Doppler Method in Highly Dynamic Environments

2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) Workshop: Cognitive and Social Aspects of Human Multi-Robot Interaction. (One of ten oral presentations)
IEEE Transactions on Automation Science and Engineering, doi: 10.1109/TASE.2022.3175039.
Kuanqi Cai, Weinan Chen, Chaoqun Wang, Shuang Song, Max Q.-H.Meng.

Link https://youtu.be/o32I_c1IxH8

Risk-aware Path Planning under Uncertainty in Dynamic Environments.

Journal of Intelligent & Robotic Systems, 2021, 101(3): 1-15.
Kuanqi Cai, Chaoqun Wang, Shuang Song, Haoyao Chen, Max Q.-H. Meng.

Link https://youtu.be/0C2OgcO_TsU

Adaptive Sampling for Human-aware Path Planning in Dynamic Environments

2019 IEEE International Conference on Robotics and Biomimetics (ROBIO), pp. 1987-1994. IEEE, 2019. (Oral presentation). EI.
Kuanqi Cai, Chaoqun Wang, Chenming Li, Shuang Song, and Max Q-H. Meng.

A Vision-Based Road Surface Slope Estimation Algorithm for Mobile Service Robots in Indoor Environments

2018 IEEE International Conference on Information and Automation (ICIA), pp. 621-626. IEEE, 2018. (Oral presentation). EI.
Kuanqi Cai, Wenzheng Chi, and Max Qing-Hu Meng.

Mobile Robot Path Planning in Dynamic Environment: A Survey

Instrumentation, 6(2):90–100, 2019.
Kuanqi Cai, Chaoqun Wang, Jiyu Cheng, Shuang Song, Clarence W.de Silva1, and Max Q.-H. Meng.

HONOURS AND AWARDS

06/2018
Student of the Year Nomination Award – Hainan University 10 out of 38,000+

2019
2 × Outstanding Students – Harbin Institute of Technology 2018-2019; 2019-2020

05/2018
Chinese University Students' Star of Self-improvement. (Nomination Award) – All-China Students' Federation, The Central Committee of the Communist Youth League Top 0.02%

10/2015
Summer Social Practice Activities Advanced Individuals – Hainan University

2015
3 × Excellent Student Cadre – Hainan University 2014-2015; 2015-2016; 2016-2017

06/2018
Outstanding Graduates – Hainan University

2015
3 × Merit Student – Hainan University 2014-2015; 2015-2016; 2016-2017

2015
3 × Honor of the most innovative and practical college student – Hainan University 2014-2015; 2015-2016; 2016-2017

12/2016
Top 100 Summer Practice Teams of Chinese College Students – China Youth Daily

2021
Best Poster Award (second place) – The 3rd TBSI-WOLT'21 Workshop on Learning Theory

RESEARCH EXPERIENCE

07/2021 – 09/2021
Flowbot: Robot Navigation in Crowded Human Flows

Autonomous Systems Lab (ETHZ) | Robotics Student Fellow | Jul. 2021 - Sep. 2021

1. Developed a flow map method that considers the velocity and density of the crowd using shear force and viscosity from fluid mechanics to build the constraints.
2. Proposed a sampling-based global path planner to yield the efficiency trajectory in the crowded area by considering the flow map method. Used the B-spline method to optimize the trajectory to match the robot motion.
3. Implemented the reciprocal velocity obstacle (RVO) algorithm as local path planner. Demonstrated the proposed planner in the “Crowdbot Challenge” simulator.

Link https://youtu.be/FfRSd2XvOcw

10/2020 – 06/2021
Dual-arm Mobile Robot With Human-robot Interaction in Uneven Terrain Environment

Shenzhen Key Laboratory of Robotics Perception and Intelligence (SUSTech) | Visiting Student | *No.JCY20170413161616163*

1. Implemented a histogram-backed projection algorithm for the robot to recognize feasible and accessible regions

2. Proposed a vision-based slopes estimation algorithm for the mobile robot in indoor environments and completed the three-dimensional mapping of uneven terrain based on real-time appearance-based mapping method.
3. Proposed a path planning algorithm based on the rapidly exploring random tree star (RRT*) algorithm combining with the continuity of slope height for both upslope and downslope.
4. Handled the systems integration and assembly of the robot (1. Built the control platform and installed sensors. 2. Used sensor data for SLAM in indoor environments. 3. Implemented an extension of risk-based, rapidly exploring random tree (Risk-RRT*) algorithm for autonomous navigation.).

Link https://youtu.be/R1s01AacUHM

03/2019 – 10/2020

An Intelligent Robotics System for Autonomous Airport Passenger Trolley Deployment

Robotics, Perception and AI lab (CUHK) (Advisor: Prof. Max Q.-H. Meng) | Research Assistant | *Hong Kong ITC ITSP Tier 2 grant # ITS/105/18FP.*

- Applied the Gmapping method to map and the particle filter method for localization in complex environments. Proposed a VLP-16 laser data processing scheme to solve localization uncertainty caused by the noise of the humans.
- Implemented the online sampling-based path planner considering the collision-risk of obstacles to yield paths. Designed the patrol route and assigned multiple patrol points according to the working environment of the trolley collection system.
- Proposed bio-direction navigation scheme to smoothly deliver the airport trolleys to the designated collection area. Tested and debugged the navigation and simultaneous localization and mapping (SLAM) assignment during the trolley collecting process in the real environment.
- Designed and implemented the scheme for two-robots to cooperate together in transporting trolleys, based on PID control, in both simulations and real environments.

Link https://youtu.be/TEDBrT6rTWE

01/2018 – 12/2018

Mobile Sorting Robot in Supermarket Environment

Robotics and Perception Lab (HIT) (Advisor: Prof. Max Q.-H. Meng) | Core Member

- Implemented the mapping and localization tasks of the sorting robot in both Stage stimulator in Robot Operating System (ROS) and the supermarket environment.
- Achieved the obstacles avoidance motion planning strategy based on the Timed Elastic Band (TEB) algorithm on the sorting robot, and realized the multi-point navigation of the robot in the supermarket environment.
- **Achievement:** Won Second Prize & Golden Egg Prize in JD Robot Challenge (Top 2/300, Bonus: $50,000).

Link https://youtu.be/4V0wS8LYz9o

07/2016 – 09/2017

Autonomous Mobile Robot for Pest Identification and Environmental Monitoring

National Training Program of Innovation and Entrepreneurship for Undergraduates | Vice-leader | *No. 201610589022*

- Accomplished the task of the robot cruising and recording the location of the pests founded along the way.
- Using AutoCAD and ProE to design the mechanical structure and the function of the robot, including the monitoring device based on gantry robot and mechanical arm.
- Applied the graph traversal method named A* to generate the global path. Used the TEB method to optimize the generate path. Completed the mapping and localization of the robot in the agricultural experimental station of Hainan University.
- **Achievement:** 1. Won Provincial First Prize in “Challenge Cup” National College Student Curricular Academic Science and Technology Works Competition. 2. Won National Special Prize in the Silk Road Robotics Innovations Competition. 3. Published two Chinese patents (Index: CN106976062A, CN107030681A).

Link https://youtu.be/OlVhF0N8Iu0

02/2015 – 10/2016

An Intelligent Device for Assisting Rubber Tapping

National Training Program of Innovation and Entrepreneurship for Undergraduates | Leader

- Investigated the technology of rubber trapping in the Chinese Academy of Tropical Agricultural Sciences and the rubber plantation in Danzhou, Hainan. Designed the intelligent rubber tapping machine by using ProE.
- Proposed an evaluation algorithm of rubber tapping technology: 1. Used Delphi method and the gray relational analysis method to determine the evaluation indexes; 2. The entropy weight method is used to give weight to the evaluation indexes; 3. Transformed the tapping horizontal quantization scores into the qualitative evaluation of the tapping level based on the reverse cloud generator; 4. Determined the center points of different tapping levels by using the k-means clustering method; 5. Tested in the Rubber trees.
- **Achievement:** 1. Published a Chinese patent (issue). 2. Published a paper in ICCCS 2017 (Second author, EI). 3. Won National Silver Award & Provincial Special Prize as a leader in China College Students' Entrepreneurship Competition. 4. Reported in the local newspaper.

10/2014 – 09/2015

Research and Design of Coconut Automatic Trepanning Machine and Coconut Meat Digging Machine

National Training Program of Innovation and Entrepreneurship for Undergraduates | Leader | *No. 20130902320022*

- Investigated the traditional methods of the extraction of coconut juice and meat. Designed the coconut meat trepanning machine with a cam and the spring link to breakdown the coconut periodically.
- Proposed automatic coconut meat harvest method. Designed a self-adjusting blade that can automatically harvest meat for coconuts of the different radius with rotary double spring, according to the different thickness and toughness between the shell and meat.
- Simulated the harvesting path of the blade and the parameters of the mechanism. Carried out the simulation experiments and error evaluation for coconuts of the different radius by using MATLAB.
- **Achievement**: 1. Published two Chinese patents (issue). 2. Published two Chinese core journals (First Author, IF=1.099).

PROFESSIONAL ACTIVITY

Reviewer

IEEE Transactions on Industrial Informatics (SCI, IF=7.377)

Reviewer

IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)

Reviewer

Advances in Mechanical Engineering (SCI, IF=1.024)

Reviewer

2020 ACM International Conference on Computer Science and Application Engineering (EI)

Session Chair

2021 IEEE International Conference on Robotics and Automation (ICRA)

Session Chair

2019 IEEE International Conference on Robotics and Biomimetics (ROBIO)

Session Chair

2018 IEEE International Conference on Information and Automation (ICIA)

PATENTS

A Four-wheel Mobile Machine Car for Loading

Kuanqi Cai, Boyi Liu, Zhuhua Hu, et al. China Patent. CN107323565A. 07/11/2017. Issue.

An Intelligent Monitoring Autonomous Robot for Recognition of Pests

Kuanqi Cai, Boyi Liu, Yan Zhang. China Patent. CN106976062A. 25/07/2017. Issue.

An Automatic Coconut Puncturing and Juice Collecting Machine

Kuanqi Cai, Boyi Liu, Xinyu Wei, et al. China Patent. CN205585269U. 21/09/2016. Issue.

An Intellegent Rubber Tapping Knife

Boyi Liu, **Kuanqi Cai**, Yan Zhang, et al. China Patent. CN106342655A. 25/01/2017. Issue.

The Design of Automatic Coconuts Meat Harvesting Machine Based on the PLC Combined with Hooke's Law

Zhenbin Chen, **Kuanqi Cai**, Boyi Liu, et al. China Patent. CN206260775U. 20/06/2017. Issue.

COMPETITION

12/2018
JD Robot Challenge

Second Prize & Golden Egg Prize (Top 2 / 300, Bonus: $50,000)

07/2017
China College Students' "Internet +" Innovation and Entrepreneurship Competition.

Provincial Gold Prize

06/2017
Silk Road Robotics Innovations Competition

National Special Prize

05/2017
"Challenge Cup" National College Student Curricular Academic Science and Technology Works Competition.

Provincial First Prize

04/2017
Microsoft Imagine Cup Competition

Provincial Second Prize

11/2016
China College Students' Entrepreneurship Competition

National Silver Award & Provincial Special Prize

04/2016
Interdisciplinary Contest in Modeling

Meritorious Winner

SCHOLARSHIP

11/2015
National Scholarship

Ministry of Education, PRC. (Top 0.1%, the highest scholarship in PRC)

2022 University College London EPSRC DTP Research Studentship

Only 18 international students were accepted

2022 University of Nottingham Horizon Creating Our Lives in Data CDT Doctoral Studentship Award

2021 "Aerospace and New Source Cup" Innovation Star (First Prize)

Harbin Institute of Technology, (1/529).

11/2016
National Encouragement Scholarship

Ministry of Education, PRC.

11/2015
Individual Scholarship for Social Services

Hainan University.

10/2018 – 09/2021
3 × The First Prize Scholarship

Harbin Institute of Technology.

11/2017
The Special Prize Scholarship

Hainan University. (Top 1%)