

Yang (Joyce) Jiao (she/her)

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SUMMARY

Self-motivated and perceptive master's graduate with almost four years of extensive research experience in robotics. Innovative thinker with enthusiasm for mathematical modeling and real robot application. Exhibits advanced coding proficiency built on rigorous research initiatives and comprehensive academic projects. Current research interest in building autonomous and intelligent multi-robot systems, focusing on simultaneous localization and mapping (SLAM) and motion planning.

PUBLICATIONS

1. **Y. Jiao**, Y. Qiu, H. I. Christensen, "Prior-Assisted Indoor Object SLAM with Long-Term Data Association," *IEEE Robotics and Automation Letters* (In progress).
2. L. Zhang, **Y. Jiao**, Y. Huang, Z. Wang, H. Qian, "Parallel Self-assembly for Modular USVs with Diverse Docking Mechanism Layouts," arXiv preprint, arxiv.org/abs/2401.15399.
3. L. Zhang, Y. Huang, Z. Cao, **Y. Jiao**, H. Qian, "Parallel Self-assembly for a Multi-USV System on Water Surface with Obstacles," *IEEE Transactions on Automation Science and Engineering*, doi: 10.1109/TASE.2024.3376981.
4. L. Zhang, X. Ji, **Y. Jiao**, Y. Huang, H. Qian, "Design and Control of the 'TransBoat': A Transformable Unmanned Surface Vehicle for Overwater Construction," *IEEE/ASME Transactions on Mechatronics*, vol. 28, no. 2, pp. 1116-1126, April 2023, doi: 10.1109/TMECH.2022.3215506.
5. Y. Huang, **Y. Jiao (co-first author)**, X. Chen, L. Zhang, X. Ji, H. Qian, "Modeling and Implementation of Tacking for Wing Sail Land-Yacht," *2021 IEEE International Conference on Real-time Computing and Robotics (RCAR 2021)*, Xining, China, July 15-19, 2021, pp. 405-410.

EDUCATION

University of California, San Diego (UCSD) 09/2022 – 03/2024

Master of Science, Electrical and Computer Engineering

La Jolla, USA

Major: Intelligence Systems, Robotics and Control | **UC-GPA: 3.918/4.0**

- Core courses: *Robot Motion Planning* (A+), *Cooperative Control of Multi-Agent Systems* (A+), *Robotics* (A), *Sensing & Estimation in Robotics* (A), *Mathematics for Robotics* (A)

The Chinese University of Hong Kong, Shenzhen (CUHKSZ)

09/2018 – 07/2022

Bachelor of Engineering with Honors, First Class

Shenzhen, CHN

Major: Electronic Information Engineering | **Major GPA: 3.806/4.0**, Cumulative GPA: 3.705/4.0

- Achievements: CUHKSZ Bo Wen Scholarship & 2020-21 Academic Performance Scholarship
2018-22 Dean's List Awards
- Core courses: *Automatic Control Theory and Linear Systems* (A-), *Optimization* (A-), *Calculus I-II* (A-, A), *Probability and Statistics I-II* (A-, A), *Programming for Robotics* (A-)

Oxford University

08/2020

Oxford Prospects and Global Development Institute (OPGDI) Online Summer Program

Module: Foundations of Human Science: Artificial Intelligence – Chemistry – Physics

RESEARCH EXPERIENCE

Prior-Assisted Indoor Object SLAM, supervised by Prof. Henrik I. Christensen

10/2022 – Present

Student Researcher | Cognitive Robotics Laboratory | UCSD

La Jolla, USA

- Implemented prior-assisted object SLAM using factor graph representation (GTSAM) and optimized with incremental solver (iSAM2). Designed prior factors and improved variable initialization to assist online updates
- Conducted experiments on the 3RScan dataset and the TUM RGBD dataset. Reduced the mapping error by 50% and the overall measurement error by 91% on average
- Solved the object-level data association by integrating short-term on-image tracking and long-term map-to-image association
- Incorporated visual odometry (ORB-SLAM3), object detection (YOLOv8), and object tracking (SORT) algorithms into a full semantic SLAM system

Bachelor's Final Year Project, supervised by Prof. Huihuan Alex Qian

12/2021 – 08/2022

Planning for Floating Structure Construction on Water Surface by Multiple Unmanned Surface Vehicles (USVs)

Shenzhen, CHN

- Designed and implemented a parallel self-assembly algorithm in MATLAB, which can be adapted for modular floating structure construction. Succeeded in simulating robot group behavior at a scale of around 10 robots and obtained an overall grade of A
- Represented the parallel self-assembly procedure by a binary tree structure (assembly tree) and proposed a method to generate a parallel construction order based on the assembly tree
- Formulated a hierarchical task and trajectory planning system and validated in simulations with obstacles in the environment

Design and Control of a Modular Transformable USV

06/2021 – 12/2021

Undergraduate Student Assistant / Robotics & Artificial Intelligence Laboratory (RAIL) / CUHKSZ

Shenzhen, CHN

- Constructed a dynamic model for the transformable USV. Participated in the trajectory tracking experiments and the docking experiments between the transformable USV and a dock via Model Predictive Control (MPC)
- Restrained the average tracking error within 3.7% in circle shape trajectory tracking. Achieved success rate of 90% (extended mode) in turbulent water
- Accomplished the parameter identification of the USV dynamic model. Employed the Trust Region Reflective method by adopting the Optimization toolbox in MATLAB

Tacking Strategy of Wing Sail Land-yacht

08/2020 – 04/2021

Undergraduate Student Assistant / RAIL / CUHKSZ

Shenzhen, CHN

- Realized the design, modeling, and implementation of upwind steering maneuver (tacking) for wing sail land-yacht
- Conducted hardware experiments and achieved the tacking with a high success rate of 94.7%, based on the predicted minimum initial steering velocity
- Developed a model describing the steering process based on the law of energy conservation to predict the minimum initial velocity for tacking
- Identified an acceleration error function induced by the environment disturbance by a series of experiments

ACADEMIC PROJECTS

Multi-Agent Assignment and Planning | MAE247 Cooperative Control of Multi-Agent Systems

05/2023 – 06/2023

- Reviewed extensive literature in multi-agent systems and demonstrated an in-depth analysis on the paper “CAPT: Concurrent assignment and planning of trajectories for multiple robots”
- Re-implemented the algorithms described in the paper. Simulated and visualized both centralized and decentralized CAPT at a scale of 10 – 20 robots. Tested with different robot sensing range
- Observed collision-free behavior of the agents with a clear trade-off between decentralization and optimality

Particle Filter SLAM and Texture Mapping | ECE276A Sensing & Estimation in Robotics

02/2023 – 03/2023

- Solved the localization problem using particle filter based on the differential-drive motion and observation models. Created a 2D occupancy grid map built on the estimated robot trajectory.
- Achieved qualitatively non-distorted mapping outcome with 200 particles and resampling threshold of 20 particles
- Processed encoder, IMU, and LiDAR data to obtain measurements of the velocity input and obstacle information of the surrounding environment. Applied the SLAM results together with RGBD image data to construct a 2D texture map

Warehouse Manipulation | ECE4310 Programming in Robotics

05/2022

- Completed a vision-based grasping and sorting task by driving a 6-DOF robot arm using ROS and MoveIt
- Improved the system efficiency by optimizing the end-effector trajectory and inserting failure detection checkpoints
- Detected object color using HSV color model and realized the eye-hand calibration. Implemented robust task planning and collision-free trajectory planning to fetch and sort items into different bins based on the detected color

Composition and Instrumental Music Generation | EIE3510 Digital Signal Processing

11/2021 – 12/2021

- Composed and created a piece of piano melody from a slice of bird song and designed a GUI for demonstration in MATLAB. Obtained scores of 100pts/100 for proposal and 98pts/100 for report and code
- Denoised the bird song using an FIR bandpass filter and achieved a signal-to-noise ratio of 10.83dB. Extracted the fundamental frequency components by spectrogram analysis to generate digital notes (keys and beats)
- Mimicked the timbre of piano based on the ADSR envelope model and by superposition of high order harmonics

PATENT

1. L. Zhang, Y. Huang, **Y. Jiao**, X. Chen, H. Qian, X. Ji, “A Control Method for Autonomous Driving of Lightweight Unmanned Wind Sail Land-yacht,” China Patent, Pub. No. CN113479060A

TEACHING EXPERIENCE

Undergraduate Tutorial Teaching / Teaching Assistant / CUHKSZ

09/2021 – 12/2021

- Taught tutorials of the course *Principles of Communication Systems* in English. Facilitated students to review lecture content, demonstrated solutions to assignment questions, and explained the physical interpretation
- Graded in-class quizzes. Offered individual support to students during weekly office hours

SKILLS

Programming Skills

- Programming languages: **Python, MATLAB, C/C++**
- Frameworks/tools: **ROS, NumPy, Matplotlib, PyTorch, Jupyter Notebook, CMake, Linux CLI, SolidWorks, Markdown, LaTeX**

Language Skills - English (fluent), Chinese (native)