

# Yang (Joyce) Jiao (she/her)

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## SUMMARY

Self-motivated and perceptive master's graduate with 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, "Real-Time Prior-Assisted Indoor Object SLAM," *IEEE Robotics and Automation Letters* (Under review).
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: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* (2024).
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: Intelligent 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: *Programming for Robotics* (A-), *Automatic Control Theory and Linear Systems* (A-), *Calculus I-II* (A-, A), *Probability and Statistics I-II* (A-, A), *Discrete Mathematics* (A), *Optimization* (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

**Real-Time 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 65% 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 object SLAM system on ROS using Intel RealSense D435, achieving a running speed of 10Hz on average

**Bachelor's Thesis - Modular Robotics**, supervised by Prof. Huihuan Alex Qian

12/2021 – 08/2022

**Thesis Title:** Planning for Floating Structure Construction on Water Surface by Multiple 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
- Represented the parallel self-assembly procedure by a binary tree structure (assembly tree) and proposed a method to generate task assignments using the assembly tree. Implemented path planning based on A\* that accounts for multi-robot coordination
- Formulated a hierarchical task and trajectory planning system and validated in simulations with obstacles in the environment

## Design and Control of a Modular Transformable Unmanned Surface Vehicle (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 a 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
- Identified an acceleration error function induced by the environment disturbance. Conducted hardware experiments and achieved the tacking with a high success rate of 94.7%, based on the predicted minimum initial steering velocity
- Developed the physical model of the steering process, which predicts the minimum initial velocity for tacking
- Designed the electronic master-slave system to process pose information from Motion Capture and send PWM control signal to servo motors using Arduino Nano

## 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 corridor maps 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:** Python, MATLAB, C/C++, VHDL | **Software:** ROS, Gazebo, Git, Docker, CMake, Linux CLI, LaTeX, Markdown  
**Hardware:** Arduino, Raspberry Pi, STM32, FPGA, Servomotor, IMU | **Laboratory:** oscilloscope, logic analyzer

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