

Kanzhong Yao

Education

01/2021—12/2024 (expected) University of Manchester

PhD Electrical and Electronic Engineering (Fully funded)

- Supervised by Dr. Simon Watson and Dr. Ognjen Marjanovic
- Project title: Multi-Agent Robotic Exploration of Confined Aquatic Environments

09/2017—07/2020 Tongji University

MSE Major in Aerospace Engineering (Full scholarship)

- GPA: 86% (top 10 of 67 students)

09/2013—06/2017 Xihua University

BSE Major in Vehicle Engineering (Honored graduation)

- GPA: 83% (top 20 of 193 students)
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Fellowship and Secondment

09/2024—10/2024 The University of Tokyo

Robotic researcher, Department of Precision Engineering, funded by Japan Atomic Energy Agency (JAEA).

- Awarded as **NEST fellow**, supervised by Dr. Nobuto Matsuhira and Prof. Atsushi Yamashita
- Development on multiple robot platform for radiation mapping and teleoperation.

06/2024—12/2024 RAICo1 Lab (on going)

Principal Investigator, funded by UK Atomic Energy Agency (UKAEA).

- Awarded as **RAICo Junior Fellow**, lead a project with 5000£ funding.
- Development on multi-agent obstacle avoidance algorithm with image sonar, for the deployment in confined underwater spaces.

01/2022—03/2022 Hamburg University of Technology

Robotic researcher, Institute of Mechanics and Ocean Engineering, funded by UK Turing Scheme.

- Supervised by Dr. Daniel A Duecker
 - Development on multiple robot platform for underwater environment inspection and exploration.
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Selected Publications and Patent

1. **K. Yao**, N. Bauschmann, T. L. Alff, W. Cheah, D. A. Duecker, K. Groves, O. Marjanovic, and S. Watson, “Image-based visual servoing switchable leader-follower control of heterogeneous multi-agent underwater robot system,” in 2023 IEEE International Conference on Robotics and Automation (ICRA), 2023, pp. 5200–5206. **Video:** <https://youtu.be/XhKV2pX1EWM>
 2. **K. Yao**, X. Cheng, K. Groves, B. Lennox, O. Marjanovic, and S. Watson, “Virtual Elastic Tether: a New Approach for Multi-agent Navigation in Confined Aquatic Environments,” submitted to **Journal of Field Robotics**, 2024, under review. **Preprint:** <https://arxiv.org/abs/2403.10629> **Video:** <https://youtu.be/iiOjSIEPRqI>
 3. **K. Yao**, O. Marjanovic, and S. Watson, “Fully Distributed Cooperative Multi-agent Underwater Obstacle Avoidance,” submitted to IEEE International Conference on Robotics and Automation (ICRA), 2025, under review. **Preprint:** <https://arxiv.org/abs/2403.10759>. **Video:** <https://youtu.be/Z-YArrn23b0>
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4. X. Cheng, **K. Yao**, M. Sandison, A. West, S. Watson, O. Marjanovic, B. Lennox, and K. Groves, “Confined Space Underwater Positioning Using Collaborative Robots,” submitted to **Journal of Field Robotics**, 2024, under review. Preprint:
https://d197for5662m48.cloudfront.net/documents/publicationstatus/218279/preprint_pdf/3ff3ba101176f4b7aff939283b18712e.pdf
 5. Y. He, **K. Yao**, B. Lennox, and F. Arvin, “Exploration of underwater environments with a swarm of heterogeneous surface robots,” in 2023 International Conference on Swarm Intelligence (ICSI), pp. 26–37.
 6. P. D. Baniqued, P. Bremner, M. Sandisson, S. Harper, S. Agrawal, J. Bolarinwa, J. Blanche, Z. Jiang, T. Johnson, D. Mitchell, E. J. Pulgarin, A. West, M. Willis, **K. Yao**, D. Flynn, M. Giuliani, K. Groves, B. Lennox, S. Watson, “Multimodal immersive digital twin platform for cyber-physical robot fleets in nuclear environments,” in **Journal of Field Robotics**, 1–20, 2024. **Video:**
<https://youtu.be/0EJ8Y8esQz0?si=ebdcqCPQqFnOUMWR>
 7. **K. Yao** and Y. Zhu, “Kinematics numerical inverse solution algorithm for arm type AFP machine based on D-H modeling,” in Lecture Notes in Electrical Engineering, Springer Singapore, Sep. 2019, pp.151–158.
 8. Zhuoyu He, **Kanzhong Yao**, Wendi Tian. Novel Electric Racing Car Debugging System: China, CN107733034A [P]. 23 February, 2018.
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Selected Project Experience

02/2023— now **Heterogeneous Multi-agent Robotic Inspection Missions**

- **Collaborators:** RAICo1 Lab, Sellafield Ltd.
- **Outcome:** Achieved autonomous exploration and inspection of a confined underwater environment using cooperative aquatic robotic platforms. Achieved mm- level of underwater localisation accuracy using multi-agent system. **Video:** <https://youtu.be/t-JMYeTfbtE>
- **Role:** Developed the ROS system for a commercial platform BlueROV2, integrated sensors such as IMU, cameras and pressure sensor on the robot. Developed vision based cooperative control strategy for the cooperative system. Delivered a video demo and an on-site demo for sponsor.
- **Note:** This research is ongoing and is targeting an on-site deployment in of the featureless legacy ponds in Sellafield, to solve the challenge the proposed in 2021. Link:
https://www.gamechangers.technology/challenge/ROV_positioning_in_featureless_pond_environments

10/2023—03/2024 **Mission-Level Encoder-Decoder for Anomaly Detection**

- **Collaborators:** University of Glasgow
- **Outcome:** A novel application of the transformer based spatiotemporal autoencoder for mission-level anomaly detection in autonomous robots, applied specifically to an aquatic robot.
- **Role:** Demonstration of the adaptability of the system with experiments conducted both in a Gazebo-based simulation environment and on a physical platform.

08/2022—09/2022 **SARESE x RNE Research Sprint 2022**

- **Collaborators:** University of Glasgow, Bristol Robotics Laboratory, Sellafield Ltd, RAICo1 Lab
- **Outcome:** Created a mixed multi-robot fleet utilising a cyber-physical systems architecture in a dynamic inspection, maintenance and repair mission. **Video:**
https://www.youtube.com/watch?v=Tz_PNtG5CGE
- **Role:** Developed Tello Drone software for pre-inspecting simulated radioactive arenas, coordinating with multi-robot fleets, and interacting with a cyber system via ROS.

03/2021—08/2021 **Autonomous Aquatic Inspection and Intervention in Nuclear Storage Ponds**

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- **Collaborators:** RAICo1 Lab
 - **Outcome:** utilising Hydromea luma 500 wireless underwater communication system to achieve wireless remote controlling of underwater robot. Characterisation of such system shows hydromea luma 500 is not suitable for confined aquatic spaces, especially under the interference of artificial lights, such as LEDs and fluorescent lights. **Video:**
https://figshare.com/articles/media/BlueROV2_tetherless/16613467
 - **Role:** Developed experiment protocol for characterisation wireless optical communication system.

07/2018—06/2019 Inverse engineering of human back physiological curve

- Used 3D scanner (KSCAN20, precision: 0.02mm) to collect point-cloud data from the back of the volunteers.
- Reconstructed the body shape and analyzed the curve characteristics for RongTai Company to design different massage chairs for people from different jobs and ages.

11/2014—06/2015 Engineering work in a FSC (Formula Student China) team

- Engaged in designing and verification work of the racing car suspension system.
- Debug the suspension system before racing.

Selected Awards

2024, Manchester Doctoral College, University of Manchester

Second prize in Manchester Doctoral College Awards and Images of Research Competition

2023, Robotics Community, University of Manchester

Most Successful Robot of the Year, for Cooperative Aquatic Vehicle Exploration System

Best Conference Paper of the Year, for the paper presented at ICRA 2023

2022, Turing Scheme, the UK's Global Programme to Study and Work Abroad

Turing PGR Placements Award.

2021, Robotics for Extreme Environments Group, University of Manchester

Best Outreach Activity of the Year, for Science X Robot Demonstrator.

2018, Tongji University

Awarded as Excellent Student in Tongji university (5 of 67).

2017, The Education Department of Sichuan Province

Awarded as Sichuan Provincial Excellent Graduates (3%)

- The highest honor of college graduation in China.

Services

Reviewer

- IROS 2023, ICAR 2023, IEEE/CAA Journal of Automatica Sinica

Experienced Platforms and Related Skills

Robots: BlueROV2 (ASV/AUV), MallARD (ASV), HippoCampus (AUV), DJI Tello (UAV), El-MallARD (UGV), Jackal (UGV), Pioneer 3-DX (UGV).

Software: Experienced and confident developing with ROS, python, C++, ViSP, Matlab. Also experienced in CAD/CAM tools such as CATIA, Solidworks, ANSYS.
