# Kanzhong Yao

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## 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)

## 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.

## 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

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/3ff3ba10117 6f4b7aff939283b18712e.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.

# 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 vison 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_environm ents

**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**

- **Collaborators**: RAICo1 Lab
- **Outcome**: utlising 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 2024, 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, Soildworks, ANSYS.