



ACADEMIC RESEARCH 2025-2026

Solving shared nuclear decommissioning and fusion engineering challenges by accelerating deployment of robotics and AI



UK Atomic
Energy
Authority



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NUCLEAR SECURITY
TECHNOLOGIES

The Robotics and Artificial Intelligence Collaboration (RAICo) is a collaboration between the UK Atomic Energy Authority, the Nuclear Decommissioning Authority, Sellafield Ltd, The University of Manchester and AWE Nuclear Security Technologies.

The collaboration is accelerating the deployment of robotics and AI in nuclear decommissioning and fusion engineering.

RAICo develops remotely operated solutions for decommissioning, including in the nuclear industry, and for the operation and maintenance of future fusion power plants.

Through the use of robotics and AI, RAICo helps remove people from harmful environments across the nuclear sector, achieving safer, faster and more cost-effective solutions.



The RAICo Academic Research theme is led by The University of Manchester and based at the RAICo1 site in West Cumbria.

The aim is to establish an academic robotics and AI capability within the RAICo programme that is linked to major academic institutions across the UK and delivers low-TRL technologies into the overall RAICo programme.



RLC: Robotic Laser Cutting in Nuclear Decommissioning

Principal Investigator:
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In nuclear decommissioning, size reduction of existing radioactive waste is paramount for its relocation and safe storage in modern facilities.

Due to the intrinsic hazard of such handled materials, there is a strong push to use robots to move humans away from harm. Cutting the material into smaller parts is usually time and labor-intensive due to manual robot programming.

This project builds on prior RAICo-funded work that developed motion control strategies for manipulator robots with real-time collision avoidance in laser cutting operations to create an automatic planner to generate the cutting sequence.

This will enable a fixed-based manipulator robot to laser cut skips with minimum human intervention, reduced time, and increased reliability and flexibility, as there will be no assumption of skips being identical.

AI-informed Robotic Handling of Samples in Nuclear Gloveboxes

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An important role of nuclear gloveboxes is to safely enable sample preparation and characterisation of active samples.

This is relevant both in operational gloveboxes used to understand samples of working nuclear machinery and for those that need to be decommissioned.

The current method for preparing samples is a manual process that solely relies on human operators, both technically and physically. The test specimens are usually in the form of a small tablet or disc that the operator will have to use a range of tools to manually cut, polish, and clean.

Adding to this complexity, the glovebox is a restrictive environment and offers the operator a limited field of vision as well as reduced dexterity due to the safety gloves. There are also significant safety risks to the operator if the gloves become damaged during the task. This research will identify use cases for the utilisation of robot-assisted gloveboxes in polishing samples and investigate the introduction of an AI-embedded system into the handling process.

The intention is to reduce the risks to operators as well as decrease the physical demand of the operators, improve ergonomics, while relying on their technical expertise and judgment.

PIONER+ Perching Inspection of Nuclear Environments: Enhancing Robustness and Capability for Deployment

Principal Investigator:
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The Perching Inspection in Nuclear Environments (PIONER) project seeks to extend the duration of operational deployment time for UAVs by utilising existing static environmental features within the inspection site, such as railings or pipework.

UAVs are often used for remote inspection as they can efficiently and effectively access difficult locations. Accessing a location with this technology also reduces the exposure of humans to harmful environments, such as areas containing radiation hazards.

Increasing deployment times will enhance existing activities and facilitate the inspection of assets that are located in more difficult to reach areas or for deployments that would benefit from a longer duration to gather data.

The PIONER system has similar functionality to previous research solutions but is less complex, more robust, lightweight, and has greater operator usability. A pan and tilt camera enables the pilot to inspect a large area independent of the UAV location.

Collaborative Human-Robot Control Interface for Intuitive Teleoperation in Confined Environments (CHRITIC)

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In teleoperating robots within complex environments, operators face challenges due to their limited perception of the remote settings, particularly in accurately sensing position, movement and contact of remote robots.

This complexity not only complicates tasks like obstacle avoidance and precise manipulations but also demands a high level of concentration from the operator during operations.

This project will develop a teleoperation system with a natural control interface, featuring dual robotic arms with real-time bilateral haptic interactions. By improving operator's perception of the remote robot in complex environments, we aim to enhance safety and efficiency in nuclear decommissioning.

A disposable long-reach self-growing snake manipulator for inspecting confined spaces in nuclear environments

Dr Xin Dong



Deploying sensors in nuclear environments is challenging, as areas of interest are often deep within long and complex installations. These environments typically feature steps, gaps, horizontal and vertical bends, T-junctions, long and narrow spaces, making navigation difficult.

In this project, we aim to design and build a disposable self-growing snake manipulator composed of a self-growing body, an active self-supportable head and inflatable stiffening elements for overcoming these obstacles. Like a snake, the proposed manipulator can access long and narrow spaces, such as pipes and duct systems. As a modular system, its length can be shortened or extended possibly up to 40m or even longer, which enables fast adaption of the manipulator for different applications in confined spaces. The inflatable stiffening mechanism enables the head to elevate and support end effectors. A full-scale manipulator will be built and tested for applications in narrow, deep, and complex environments, which are common in nuclear facilities.

Next Generation Remote Inspection of Confined Spaces

Prof Gordon Dobie

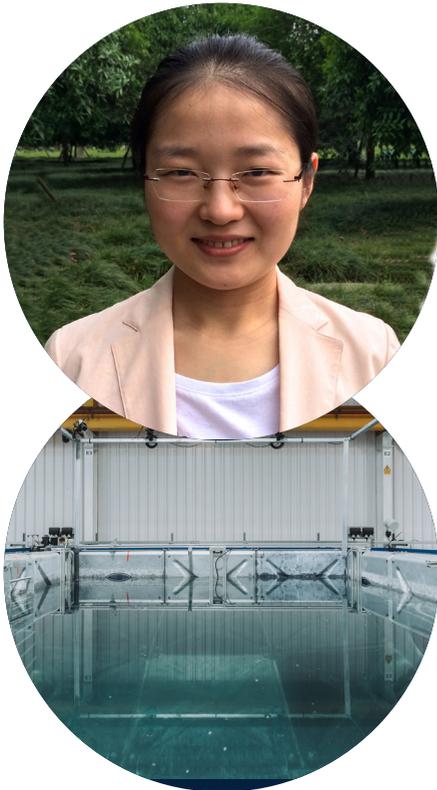


Safety-critical nuclear infrastructure is inspected periodically with quantitative techniques to monitor for degradation. This is crucial as the consequences of nuclear asset failure can lead to loss of life and long-term ecological damage. Limitations on human dose rates place significant constraints on utilising manual inspection.

Robots have the potential to provide better quality inspections without putting an operator at risk. Existing solutions don't provide the quality of a manual inspection, often due to reduced perspective and contextual awareness, therefore presenting an increased risk of asset failure. This project will develop a mixed system for remote inspection. It will build upon existing work to control a robot through a VR interface, improved by tightly coupling the inspection results into the virtual environment. Thus, enabling the operator to easily navigate through the inspection area, and visualise past and present inspection data superimposed onto the structure, allowing for better real-time decision-making.

Real-time 3D Reconstruction in Underwater Environments

Dr Emma Li



The decommissioning and cleanup of nuclear facilities, particularly in underwater environments involving submerged radioactive debris, present significant technical challenges.

Accurate 3D reconstruction of underwater environments is critical for robotic navigation, manipulation, and safety planning. However, traditional reconstruction techniques struggle with the unique constraints of nuclear environments, such as complex occlusions, the scattering effects of water and the limited communications and computing capacity. This project will develop a novel approach for real-time, high-fidelity underwater 3D reconstruction from videos captured by a camera mounted on an underwater robot, offering advantages in efficiency, robustness, and adaptability compared to conventional methods. In this RAICo funded project, we expect to deliver a demonstration system (TRL5) with the Sellafield robotics team and demonstrate the value to the NDA.

RAICo Fellows



The RAICo Fellowship supports the pioneering work of early career researchers and PhD students as they advance their research in the field of nuclear robotics. In turn, these participants contribute to the goals of the RAICo programme by helping to inform our cutting-edge research and by enriching our academic community.

The programme offers grant funding alongside a package of support that is bespoke to each individual researcher, including mentorship, workshops and career coaching. The Fellows are able to build on their knowledge of the sector with site visits to nuclear facilities across the country as well as meetings with key contacts in industry and academia. Each Fellow has the opportunity to work at RAICo1, a collaborative research facility in West Cumbria that houses many of the RAICo programme's flagship projects. During their time at the RAICo1 site, the Fellows are able to access equipment and demonstration spaces, as well as working alongside our RAICo staff members from UKAEA, Sellafield Ltd and The University of Manchester.

RAICo Fellows 2024 – 2025

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