

# Robotics and Artificial Intelligence

Robotics and Artificial Intelligence at the University of Birmingham has a long heritage stretching back decades. The breadth of research in this area provides a great number of strengths and offers solutions to a wide variety of sectors and applications. The University's Intelligent Robotics Lab (IRLab) works on the development of algorithms to enable the autonomous control of robots and other systems, and the application of these algorithms to real-world problems.

The IRLab has developed one of the world's most sophisticated visual tracking algorithms, and works with international partners on the evaluation of tracking algorithms on challenging datasets.

Birmingham's Extreme Robotics Lab (ERL) is already market-leading in many of the components that are needed for the increasing efforts to roboticise nuclear operations and have recently been successful in a bid to host and lead the National Centre for Nuclear Robotics, in collaboration with a number of other universities and industry partners.

## Expertise

- Computer vision
- Mission, task and control planning algorithms
- Problem solving and reasoning
- Grasping and manipulation
- Applied robotics
- Human Interface Technologies (HIT)

## Success and impact

- Birmingham ERL researchers developed state-of-the-art algorithms and control methods, which recently achieved the first ever deployments in history of autonomous robots in nuclear sites (AI-controlled, vision-guided grasping of inactive waste materials at NNL Workington in 2016; and AI-controlled, vision-guided robotic laser-cutting of contaminated metal inside a real radioactive hot-cell at NNL Preston in 2017).
- We have developed mission, task and control planning algorithms for both single robots and fleets of robots operating in a

coordinated fashion. Our planning algorithms have been deployed on real robots for logistics task planning, security patrolling and facilities management.

- Our work on vision, planning and manipulation has allowed robots to learn new shapes and objects, and plan how to grip and lift them autonomously. Our developments are now being transferred to manufacturing and nuclear domains.
- Professor Rustam Stolkin has been awarded Royal Society Fellowship for advanced robotic nuclear decommissioning research.

**THE BIRMINGHAM EXTREME ROBOTICS LAB (ERL) IS EUROPE'S MOST PROMINENT UNIVERSITY LAB DEDICATED TO NUCLEAR AND OTHER EXTREME ENVIRONMENT APPLICATIONS OF ADVANCED ROBOTICS AND AI**



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## Key projects

**Robotics for extreme environments:** The University of Birmingham is leading the way in developing robotic platforms and systems for use in extreme environments where human intervention is not possible, unsafe or in others ways undesirable. Birmingham is the lead university in the National Centre for Nuclear Robotics, developing technology for the nuclear sector including the sorting and segregation of existing waste, the maintenance of nuclear facilities, and the development of integrated systems for nuclear new-build projects.

**RoMaNS – Robotic Manipulation for Nuclear Sort and Segregation:** This is a new cutting-edge robotic technique in development to assist nuclear waste clean-up. The project is a collaborative EU Horizon 2020 project including the University of Birmingham, National Nuclear Laboratories (NNL), French Alternative Energies and Atomic Energy Commission (CEA), and the National Centre for Scientific Research (CNRS).

**Human Interface Technologies (HIT):** As well as researching the use of small, 'sacrificial' UAVs to gather specific intelligence relating to remote and hazardous environments, the team is also undertaking internationally acclaimed research addressing concepts for the display of real-time multi-sensory data. These include video, GPS, thermal, radiation, among others, for enhancing human situational awareness delivered via MxR command and control set-ups.

The HIT Team is part of the Mayflower Autonomous Ship and is developing a new MxR 'Science Station' concept, which will enable the public and schoolchildren to take part in the unmanned transatlantic crossing scheduled for 2020.

**Communications, microwave devices and systems:** Our research in this area focuses on the applications of microwave technology into communications and radar, and on novel aspects of network design. With funding from the EU, research councils, MoD and industry, this research covers both basic science and applications. An example of basic science is the work on materials such as dielectrics, ferroelectrics and superconductors. This basic work is complemented by the development of devices such as new, passive and active microwave circuits for real-world applications for automotive and defence sectors.

## Getting in touch

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**BIRMINGHAM'S EXTREME ROBOTICS LAB (ERL) IS LEADING COLLABORATIONS WITH NUCLEAR AND/OR SPACE AGENCIES OF FIVE COUNTRIES ON THREE CONTINENTS WITH A CURRENT INDUSTRIAL STRATEGY FUNDING IN EXCESS OF £11 MILLION**



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