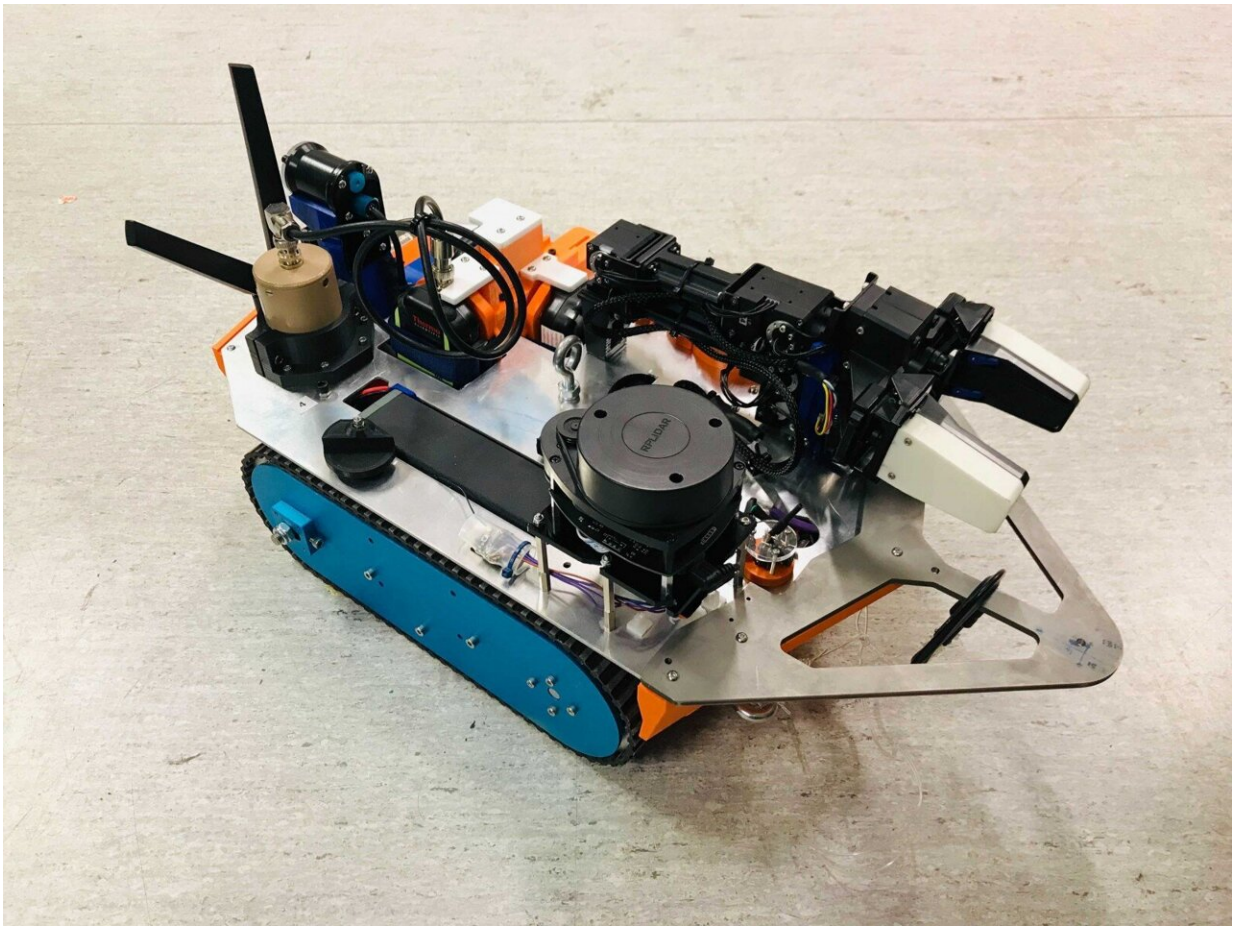
A robot called Lyra is helping transform nuclear infrastructure inspection

April 26 2022, by Ben Robinson



Credit: University of Manchester

A robot named Lyra has been used to inspect a ventilation duct in

Dounreay's redundant nuclear laboratories and map radioactive materials. Lyra traversed 140m of duct from a single entry point and provided operators with detailed radiological characterization information that can now be used to help plan safe and efficient decommissioning of the laboratories.

Previously, gaining this amount of detailed information would be complex and, even where possible, it would require operations staff to make additional airline suit entries into contaminated areas, increasing cost and elevating risk. Human access to this area is currently impossible due to the size of the duct and radiological risks.

This deployment has proven that mobile robots can be used to accelerate the pace of decommissioning legacy nuclear facilities in the UK, while at the same time reducing the risk to humans, decreasing costs and even reducing the amount of additional low-level waste that is generated during decommissioning.

Lyra's design

Lyra was designed as a low-cost robot, featuring 5 radiation detectors, a laser scanner for positioning, 2 cameras, lights and a manipulator arm that was used to take swab samples of the radioactive contamination from the wall or floor of the duct. Lyra was developed by researchers at The University of Manchester, working within the Robotics and Artificial Intelligence for Nuclear (RAIN) Hub and with considerable guidance from technical and operations staff at Dounreay Site Remediation Ltd (DSRL).

Lyra was fitted with tracks and given a relatively high ground clearance to enable it to clear the considerable amounts of rubble that lay in the duct. The radiation sensing package was designed to be able to measure beta, gammas, X-ray, and neutrons radiations and a 5 DOF manipulator

was attached to enable it to collect swabs for further radiological analysis at the site laboratories

Cameras were attached to the front of Lyra and to the end of the manipulator. The camera attached to the manipulator allowed for detailed inspection of any areas of interest that were identified during the survey. Lyra is controlled via joypad, which is used for driving, and a compliant manipulator arm whose motion is copied by the arm on the robot.

The radiation sensing package coupled with the LIDAR radar, live camera footage enabled a 3D, time stamped video to be developed with the radiation readings as measured overlayed onto the video such that any point of interest or high radiation measurement could be pin pointed at any selected location within the duct.

Lyra was untethered, but did incorporate a winch retrieval mechanism, which could be used to drag Lyra back to an access point in the event of a loss of power, or to shift it off rubble if it became beached. An independent, remote reset was also incorporated onto Lyra. This was a wireless device that enabled Lyra to perform a 'hard reset' if necessary.

The deployment

The deployment of Lyra was completed in partnership with the operations team at DSRL and the figure below shows an image of the access port, within containment, that Lyra was deployed through. The frame that is being inserted provides additional cameras, lighting and back-up communications.

Following the successful deployment of Lyra, DSRL Project Manager Jason Simpson said: "DSRL is greatly indebted to the team from The University of Manchester, their efforts coupled with that of FIS360

Managing Director Frank Allison have clearly demonstrated the substantial benefits to be gained through collaborative working with the supply chain. Now that the characterization survey is complete, we have built up a comprehensive picture of the duct which will help us make informed decisions on how the duct will be decommissioned going forward.

"Although it is recognized that the incentives to succeed differed for all parties, the enthusiasm and commitment from Frank Allison, Barry Lennox, Matthew Nancekievill, Keir Groves and the rest of the team at Manchester, ensured our objectives ultimately aligned to culminate in the successful deployment and data capture witnessed via Lyra."

RAIN Hub Director Barry Lennox added: "We wanted to demonstrate that the robot could be used successfully in active areas. We added fail safe devices, including a remote 'reboot' switch, and a winch to enable us to physically retrieve the robot if it got stuck on the debris in the duct. The survey has demonstrated Lyra's reliability in active areas."

The deployment was supported by innovation and technology transfer specialists, FIS360. Their Managing Director, Frank Allison said: "The development and deployment of Lyra highlights the benefits that robotics technology offers the nuclear industry and the importance of academia, end-users and businesses in the supply chain working together. It is only through collaborative working, like this, that solutions can be developed for complex challenges, such as surveying the Dounreay duct."

The research team are grateful for the use of the Lyra robot, which was made available for this work through the NNUF Hot Robotics Program.

The Lyra robot is one example of mobile robotic platforms designed for inspection of hazardous environments and is commercially available

through Ice Nine Ltd

More information: For further information regarding this work, please see:

rainhub.org.uk

uomrobotics.com

www.fis360.com

hotrobotics.co.uk

ice9robotics.co.uk

www.gov.uk/government/organisations/dounreay

Provided by University of Manchester