SOUTH WEST NUCLEAR HUB

HOT ROBOTICS
University of Bristol

Project title: **Remote radiation mapping surveys in the Chernobyl Exclusion Zone**

Research area: Nuclear Hazards and Risks

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Partners: Oxford Robotics Institute, ChNPP, ISPNPP

Funders: EPSRC, NCNR, NNUF

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The Challenge

The accident at the Chernobyl nuclear power plant in 1986 led to radioactive isotopes being spread around the region (and beyond) leaving areas uninhabitable, whilst a much wider area was evacuated due to safety concerns.

Over 35 years has passed since the accident and whilst some radioactive isotopes have now decayed, others will remain for hundreds or thousands of years, creating hazards for humans and wildlife. Some of these areas are still inaccessible for humans and therefore creates a challenge to map and monitor the most dangerous areas. This includes the New Safe Confinement (NSC) that surrounds the stricken reactor 4 within the power plant itself.

The Solution

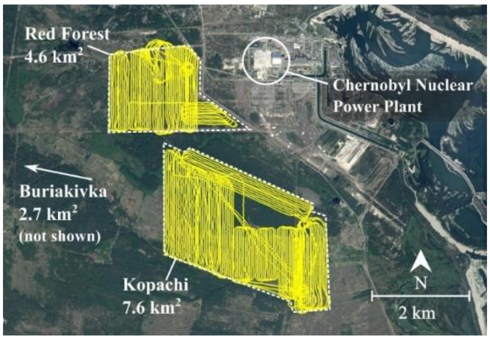

Figure 1: The areas mapped using UAVs in some of the worst-affected areas of the radioactive fallout plume

Over the course of four fieldtrips to Ukraine, the team has developed a suite of radiation mapping technologies using unmanned aerial vehicles (UAVs) and unmanned ground vehicles (UGVs) equipped with gamma-ray spectrometers and other scanning.

The team first conducted surveys of numerous interest areas in the Red Forest exclusion zone, using a DJI M600 UAV. Starting at the lowest risk site first, the village of Buriakivka, located 13 km from the accident epicentre, researchers moved on to the partially-demolished settlement of Kopachi before tackling the Red Forest – one of the most highly-contaminated natural sites on Earth.

A scanning LiDAR (Light Detection and Ranging) pod was used to generate a terrain model, followed by a gamma spectrometer to measure the radiation intensity. This allowed the team to produce a highest resolution radiation map ever recorded of several areas.

Over nine field days, the total airborne time was 24 hours covering 730km to produce comprehensive 15 square kilometre radiation map. In a world first, fixed-wing drones were used to quickly map radiation over larger areas, flying at a height of 45 m - 60 m at a speed of c. 40 mph (65 km/h). Rotary drones were then used for more detailed investigation of key areas.

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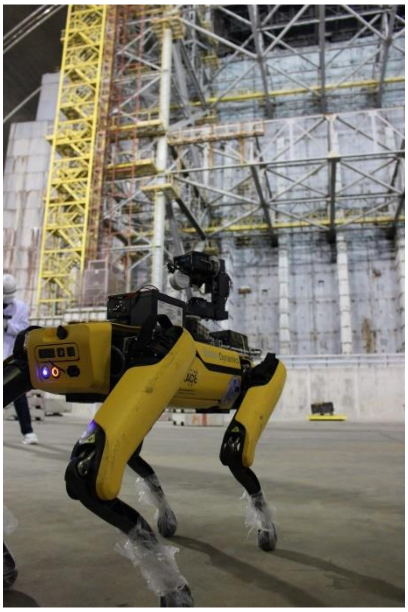
During another visit researchers were given privileged access to the control room of Reactor 4 and other areas in the NSC where they deployed specially developed radiation mapping and scanning sensors. This included the use of the Boston Dynamics *Spot*, a dog-like quadruped robot (pictured, right) to demonstrate its ability in hazardous environments.



The team demonstrated several robotic systems, fitted with ground-breaking sensing equipment developed between the universities of Bristol and Oxford as part of the RAIN project. The aim of each system was to collect highly accurate 3D models of the facility, coincident with radiation data, to accurately define the distribution and severity of the radiological risks.

The Impact

The discovery of radioactive hotspots previously undetected will allow local authorities to recategorise zones, update safety protocols and allow the return of humans and wildlife. This work will allow further safe areas to be identified and allow greater economic, social and environmental benefits to be realised.

Furthermore, the high-end 3D visualisations achieved by the team's mapping technology will aid the safe decommissioning of the power station, ensuring the dismantling of the original sarcophagus can be completed successfully.

This work has also demonstrated that the UK now has the capability to monitor radioactive sites and respond to nuclear incidents without exposing humans to risk. Detailed information can be gathered on a contaminated area from a safe zone, and be streamed live in real-time during the flight to researchers positioned in a safe zone.