

Defence Innovation Network's

# *TECH* SHOWCASE

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2022

## World-leading prototypes for Defence



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DIN is proudly funded by:



## 1 Novel photon source for quantum information processing

The project will develop a low-cost device that will support quantum key distribution, a form of quantum communication in which an encryption key is shared over a quantum channel to create an ultrasecure data link.

This technology is based on the cutting-edge field of defect-based quantum emitters in 2D materials. As a result, the team will eliminate optical instabilities in the 2D boron nitride and develop the first solid-state source of indistinguishable photons robust and suitable for real-world quantum applications.

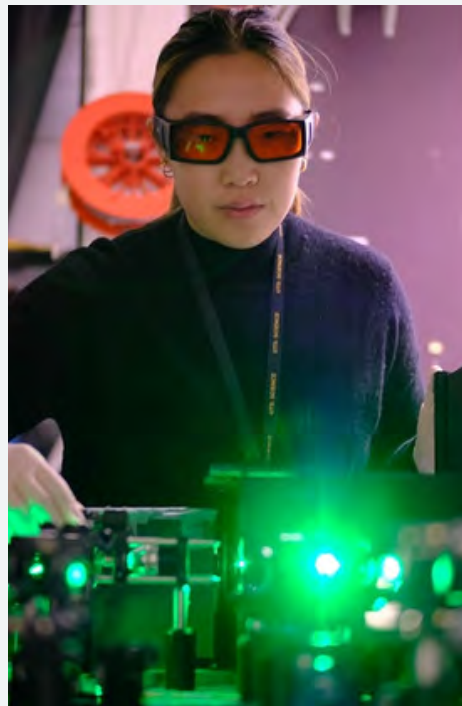
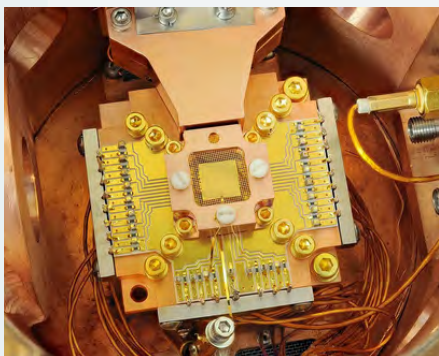
The technology will have significant implications for Australia's national security, not only securing the process of sending information but also preventing adversaries from decrypting this information.

## 2 On-chip quantum magnetometer based on nitrogen-vacancy centres in diamond

The project will develop a prototype of a world-leading quantum positioning, navigation and timing system, able to navigate in GPS denied environments. The device will push boundaries on size, weight, power and precision.

The technology is based on the CMOS-integrated quantum sensor that takes advantage of on-chip balanced detection and transimpedance amplification as a miniaturized, highly sensitive, accurate and robust magnetometer.

The solution will deliver a single "box" containing the optical, microwave and electronic components to send control and readout signals to a diamond quantum sensor to measure a change in a relative magnetic field.



Quantum

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### Resilient and trustworthy edge computing

The project will deliver an edge computing platform able to passively assess trust, and make decisions from untrusted noisy data using machine learning. In addition, the prototype will provide a safe environment for very sensitive edge-based distributed defence and Industry 4.0 applications.

It is expected that project outcomes will have a significant impact worldwide and will influence the architectural design of future edge computing systems.



Cyber

Undersea surveillance



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### Signal designs for joint communication and sensing for underwater environments

The project will deliver a ground-breaking, reliable, efficient integrated communication and sensing technology that will transform the architectural design of future undersea systems, leading to new Defence capabilities.

The technology, based on delay-doppler domain processing technologies, will enable long-distance, high-rate and covert communications and sonar sensing in mid-to-deep undersea environments.

Apart from Defence, the project has applications in ocean monitoring, underwater exploration of natural resources, diver communications and sports

## 5 Fast acquisition and imaging module for space domain awareness

The project will demonstrate a space-based fast acquisition and imaging module enabling imaging of satellites with unprecedented spatial resolution leading to breakthrough capabilities.

Its unique sensor package will enable maximal utilisation of space assets to achieve unparalleled space domain awareness information.

Cross-referenced with onboard data, the discovery of defence-relevant events will trigger communication to the ground within 3 hours, achieving complete, real-time awareness of large and small activities in space.

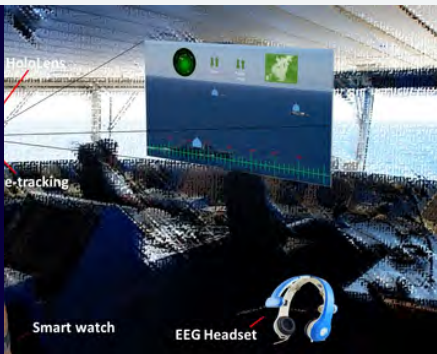


## 6 Cognitive Intelligent Navy operations heads-up interface

This project aims to design and develop an augmented reality heads-up interface focused on Navy navigation and operational environment requirements.

It will be capable of undertaking a real-time mental load assessment to evaluate the efficacy of the application in a simulated Navy operation experiment.

The project will use deep learning based algorithms to extract neurophysiological signals to detect cognitive load in real-time using NOHUI interface.



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## Neuromorphic Audio-Visual Scene Analysis for Underwater Collision Avoidance

This project will develop a low-power, real-time neuromorphic audio-visual collision avoidance system for autonomous underwater vehicles.

The system will be robust to multiple sources of noise and acoustic signatures of other vessels and will maximise information collection in poor visibility conditions above and below the water. It will have a high dynamic range to sense in presence of extreme lighting conditions and generate minimal amount of information data.



Undersea Surveillance



8

## Next generation sonar signal processing for buried naval mine detection

By fusing novel, time-series based signal processing techniques with advanced image-based approaches the project team can detect, localise and classify underwater buried targets using sonar.

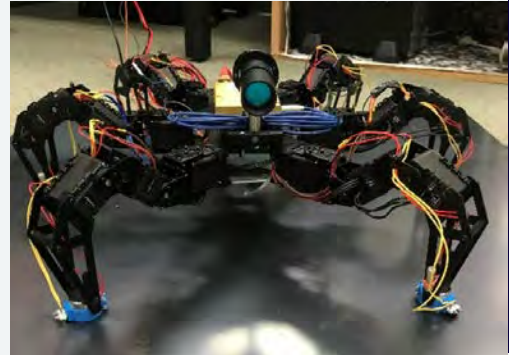
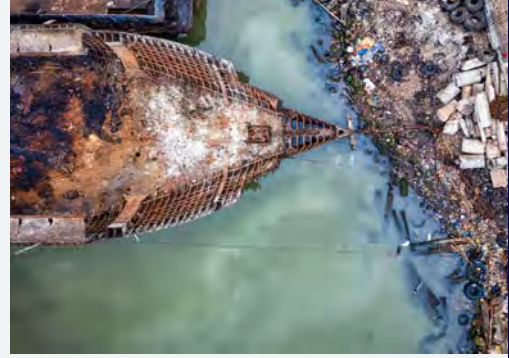
The technology is able to reliably detect mine-like objects even when buried significantly below the seabed surface. This major breakthrough relies on the interpretation of raw active sonar signals using time-series signal processing approaches and uses small training data sets to achieve highly precise results.

The technology has application in defence, underwater autonomy, oil and gas industry, marine conservation, and vibro-acoustic object classifications.




9 **Robo-Laser: A Novel System for Remediation of Marine Corrosion Using Laser Carrying Spider Robots**

The lack of robotic platforms with desirable features, power requirements for laser ablation systems, potential adverse impacts of laser's thermal energy on the metallurgical properties of treated components, heavy weight and large physical dimensions of conventional laser ablation systems are the main challenges of management of marine corrosion.

The team has demonstrated world first agile 6-legged robotic platform fitted with electro-magnets pads and a remote-controlled miniaturised laser ablation unit. The robot is capable of undertaking complex movement and corrosion removal in irregular, vertical, or even overhanging, spaces.



## Contact details

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