



# UTS Australian Artificial Intelligence Institute AAIL

*Industry showcases*

Jie Lu

Director of AAIL

AUSTRALIAN ARTIFICIAL INTELLIGENCE INSTITUTE

# Introduction

**2017: The Centre for Artificial Intelligence (CAI)**

**2020: The Australian Artificial Intelligence Institute (AII)**



## *Leadership Team*

Dist. Professor Jie Lu (Director)

Dist. Professor CT Lin (Co-Director)

Professor Ying Zhang (Research Director)

**AII currently has:**

- **35 Staff**
- **8 Postdocs**
- **200+ PhD students**

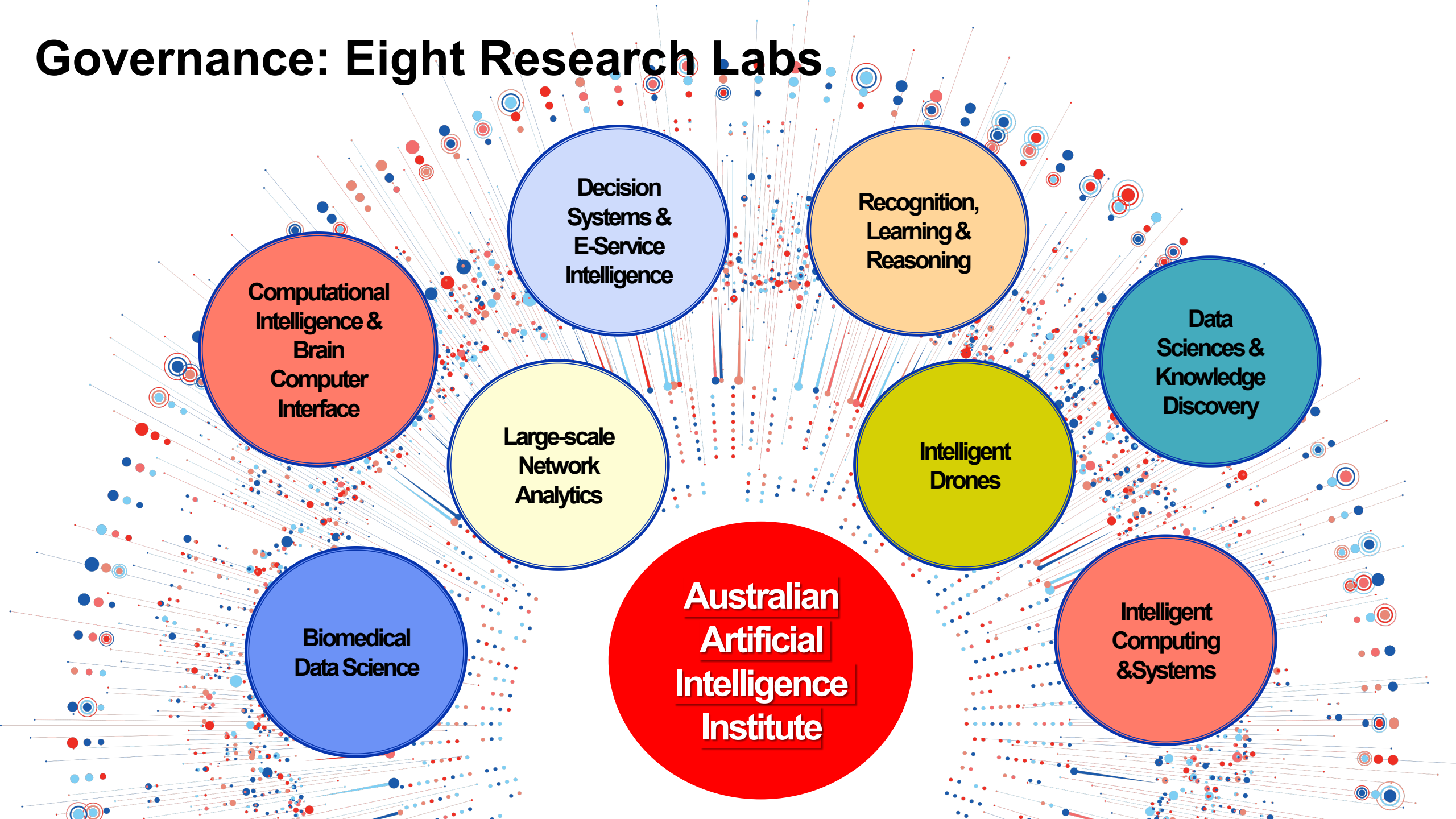
Since 2017, we have received:

- **34 Australian Research Council (ARC) projects**
- **60 industry projects**

UTS has achieved the top position in AI research in Australia – AII made significant contributions.



# Governance: Eight Research Labs



# Vision and Objectives

## Vision

To achieve excellence and innovation in sustainable and comprehensible AI by developing powerful and theoretical foundations, innovative technologies and application systems, and leading knowledge advancement that translates into significant social and economic impacts.

## Objectives

1. To construct theoretical foundations, frameworks and methodologies for AI.
2. To develop advanced technological capabilities of AI, including translatable models, tools, prototypes and systems.
3. To explore transformative applications with industry and government partners for AI.
4. To establish strong university–industry–government and international-domestic networks for AI research.
5. To train the next generation of researchers in AI.



# Research Strengths

## FUNDAMENTAL RESEARCH

- Computational Intelligence
- Transfer Learning
- Deep Learning
- Large-scale Graph Processing
- Concept Drift
- Reinforcement Learning
- Computer Vision
- Semi-supervised/Unsupervised Learning
- Probabilistic Machine Learning
- Big Dimensionality
- Knowledge Discovery
- Neuromorphic Computing
- AI-Driven Software Security Analysis

## TECHNOLOGY TRANSFER RESEARCH

- Brain Computer Interface
- Recommender Systems
- Social Networks
- Decision Support Systems
- Cloud Computation
- Blockchain
- Human Autonomy Team
- Bioinformatics
- Data Visualisation
- Text Mining
- AI Privacy & Security

## APPLIED RESEARCH

- Health Care
- Defence
- Manufacturing
- Financial Services
- Internet of Things
- Business Intelligence
- Logistics
- Transport
- Education
- Marine Safety
- Property
- Food and agriculture
- Weather Prediction
- Telecommunication

# **10 Selected Industry Applications**

developed by AAll staff

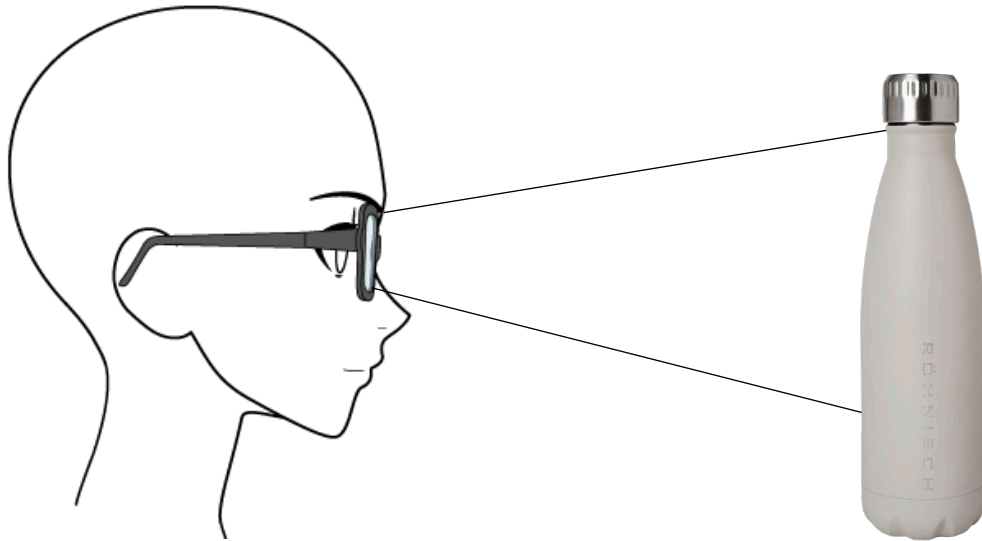
# Bionic visual-spatial prosthesis for the blind

**Description:** Evaluating the human factors of using a wearable audio rendering device to assist people who are visually impaired. The result will support future preclinical evaluations, build early prototypes, undertake preclinical trials, and prepare for future clinical trials.

**Industry Partners:**

**ARIA Research.  
University of Sydney.  
University of  
Technology Sydney.**

Understanding human factors such as mental workload, stress, and fatigue, when using ARIA's wearable device.



Performing user studies with people who are visually impaired to better gauge the usability and feasibility of the device.



# Miniature physiological sensors and decoders for brain-robot interaction

**Description:** The technology we show here is

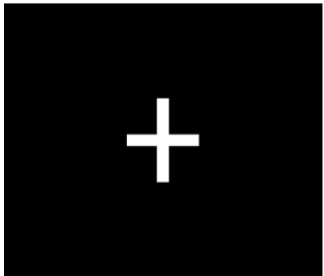
- A Brain-Robot Interface (BRI). It allows the control of machines with brain waves.
- Like the Ghost robot you can see here. It can be controlled by thought. Completely hands-free.
- We have invented a brain wave decoder for our BRI, supported by AI and graphene sensors that are super efficient.

**Industry Partner:**

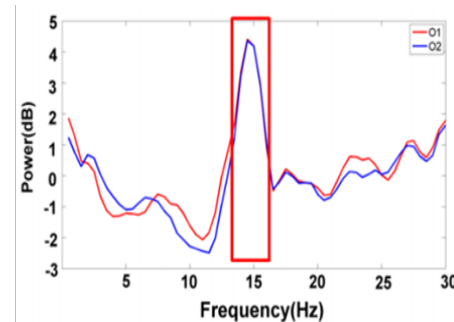
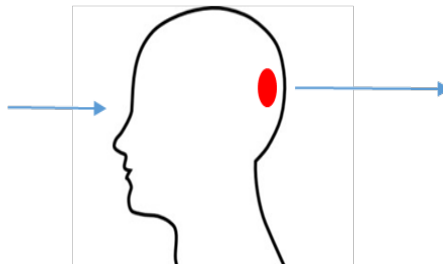
**Australian Defence  
Innovation Hub (DIH).**

Miniature physiological sensors and decoders for  
brain-robot interaction

[australian-army\\_rico](#)



SSVEP (15 Hz)



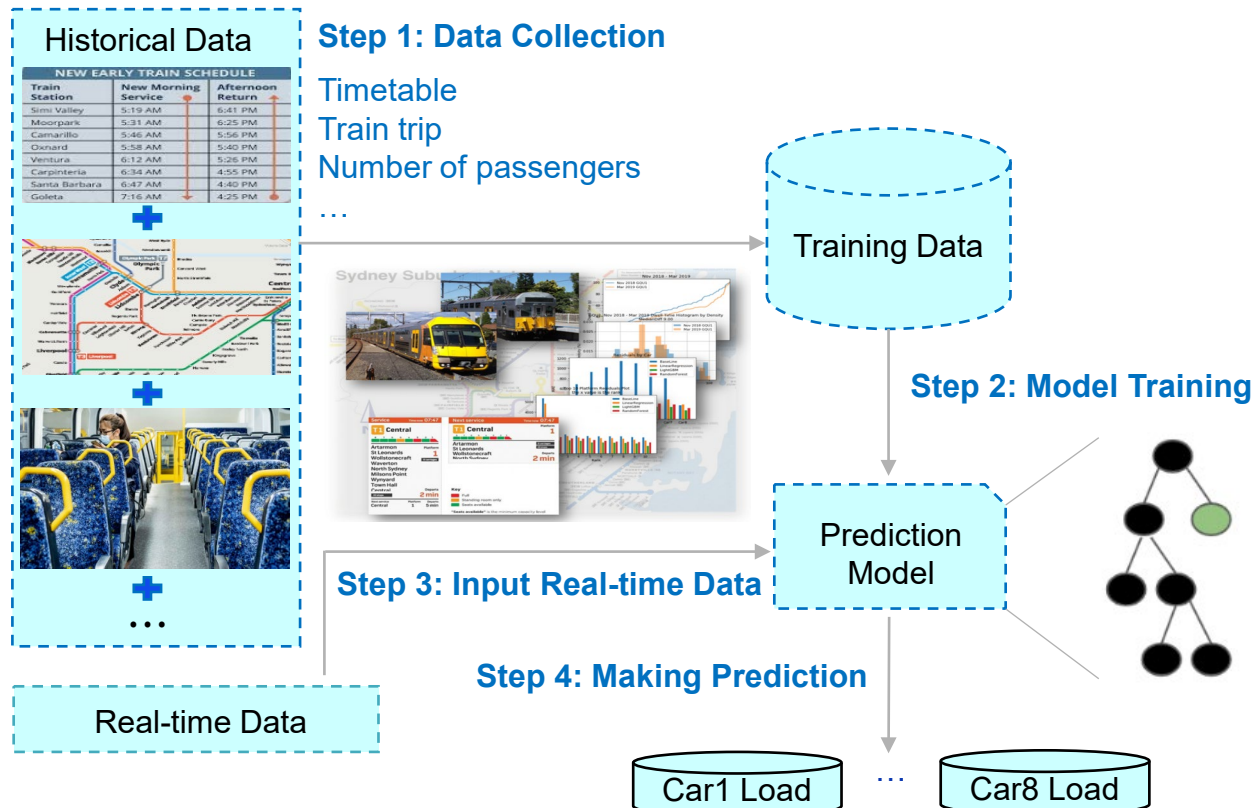
# Machine Learning-based Sydney Trains Carriage Load Prediction

**Description:** When a train leaves the platform, knowing its carriage load (the number of passengers in each carriage) will support train managers at subsequent platforms to avoid congestion by directing passengers to the less crowded carriages.

This project presents an intelligent system, which is developed in collaboration with Sydney Trains, for the real-time prediction of carriage load across a city passenger train network.

**Industry Partner:**

**Sydney Trains.**



Working with Sydney Trains on real-time carriage load prediction





# Real time shark detection system for Unmanned Aerial Vehicles/Drones

**Description:** Recreational tourism contributes significantly to the Australian economy, and shark attacks create a negative impact. Current response techniques are dated and invasive to the marine ecosystem.

This project presents the world's first automatic, real-time artificially intelligent shark detection system for Unmanned Aerial Vehicles (UAV)/Drones. SharkSpotter© is more than 90% accurate. Current traditional techniques are less than 30% accurate!

**Industry Partner:**  
**Ripper Corporation.**



- **Awards:** 3 State, 2 National, 1 Asia pacific
- **More than 3500 media articles** (e.g. BBC, World Economic Forum, New York Times, Aljazeera, Discovery Channel, Reuters, etc.) published.



Little Ripper© Drones equipped with an artificial intelligence application: SharkSpotter©



# Drone Detection using Deep Learning and CNN

**Description:** It's been called 'the future of warfare.' Off-the-shelf unmanned aerial systems (UASs), carrying a 'payload' of explosives or biological material, flown by terrorists or enemy armed forces into a crowded building or military base.

This project presents the vision system developed by the Intelligent Drone lab and ASX listed defense tech company DroneShield, produced to better identify threats from these aggressive UASs.

**Industry Partner:**

**DroneShield.**

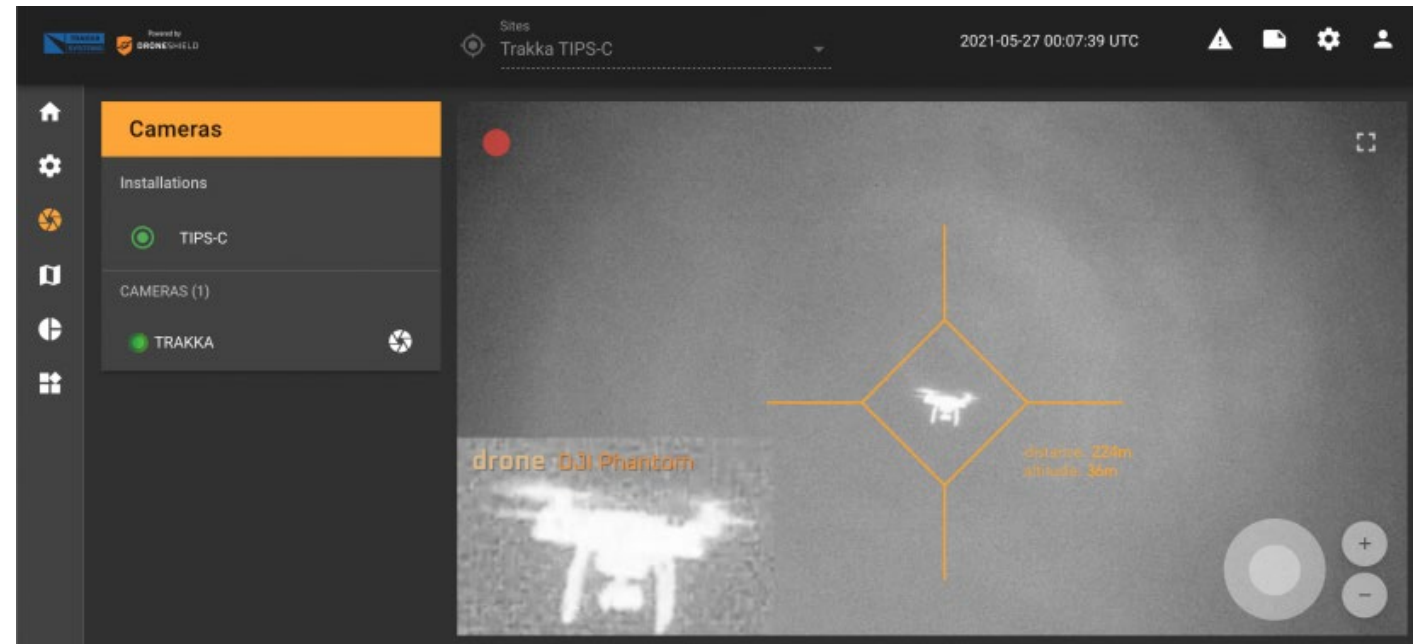
## Awards: AIIA State iAwards 2021

- 'Business Industry Solution of the Year'
- 'Technology Solution of the Year'

Funded by Defence Innovation Network (DIN) and Innovation Connections (IC) grant

## DroneOptID AI-based system in thermal mode deployment.

Image: Supplied by DroneShield



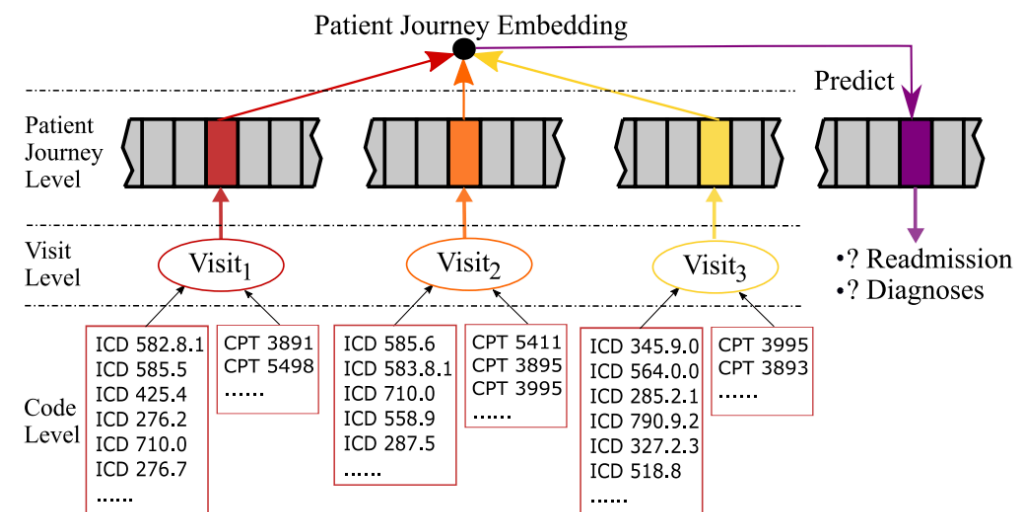
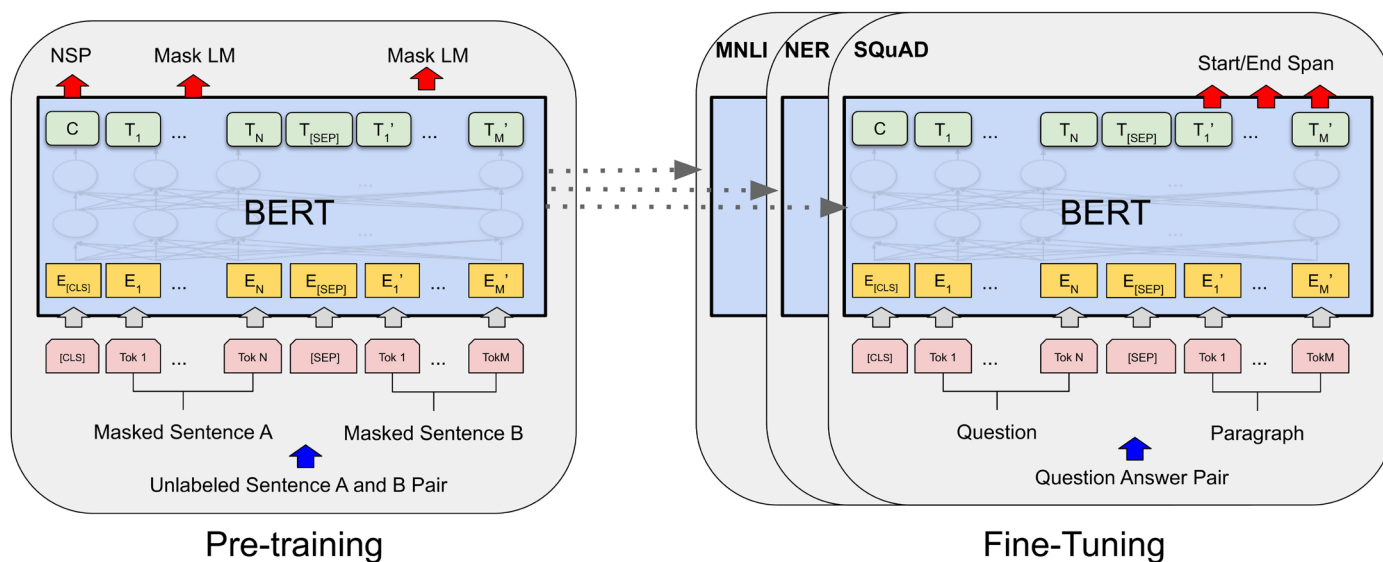
# Foundation Model for Healthcare

**Description:** As the amount of health data being collected and linked continues to grow in enterprises and government, so does the need for methodologies to overcome data complexities that are limiting its value in the real world. A new work mode is required to empower analysts to deliver evidence-based high-level decision-making using complex linked data.

This project aims to develop an industry-specific foundation model by leveraging large-scale deep learning techniques to preserve general knowledge hidden in big data.

**Industry Partner:**

**Australian Government  
Department of Health  
and Aged Care.**





# Train, Deploy and Adapt Elastic Deep Learning Models for Biometric Recognition

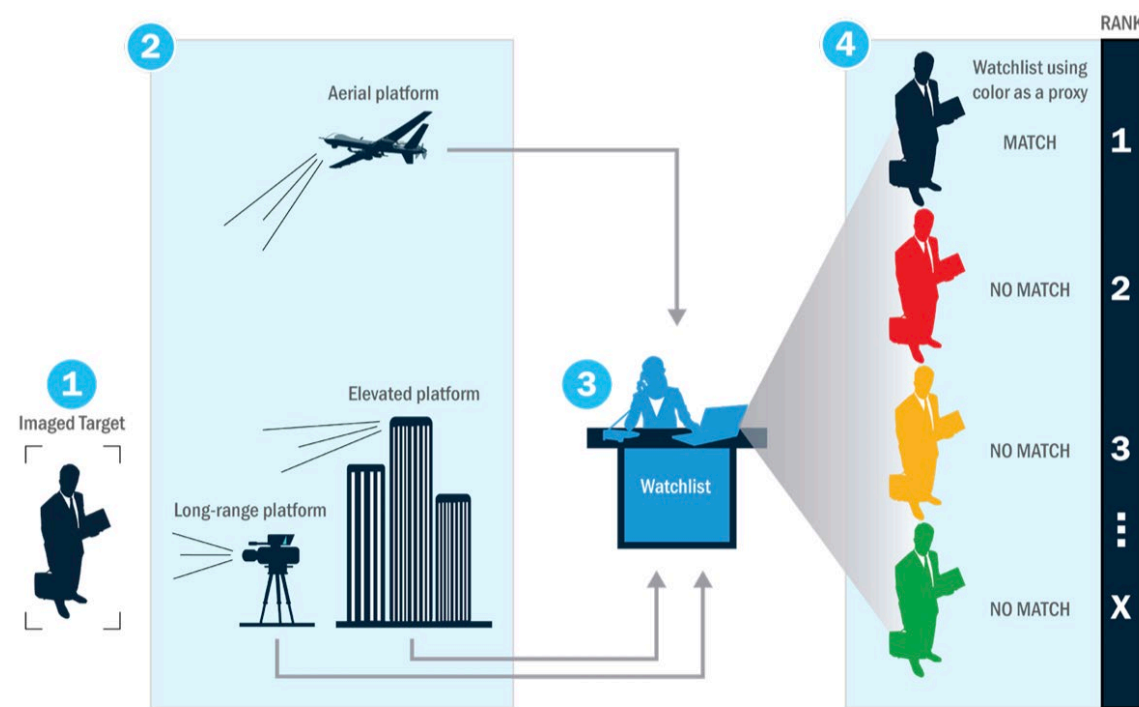
**Description:** This project aims to provide the Intelligence Community with the ability to perform accurate and reliable biometric identity intelligence across a wider range of imagery and collected from a wider selection of sensor platforms. Many Intelligence Community agencies require the ability to identify or recognise individuals under challenging scenarios, such as at long-range, through atmospheric turbulence, or from elevated and/or aerial sensor platforms.

**Industry Partner:**

**Intelligence  
Advanced Research  
Projects Activity  
(IARPA).**



## Biometric Recognition and Identification at Altitude and Range



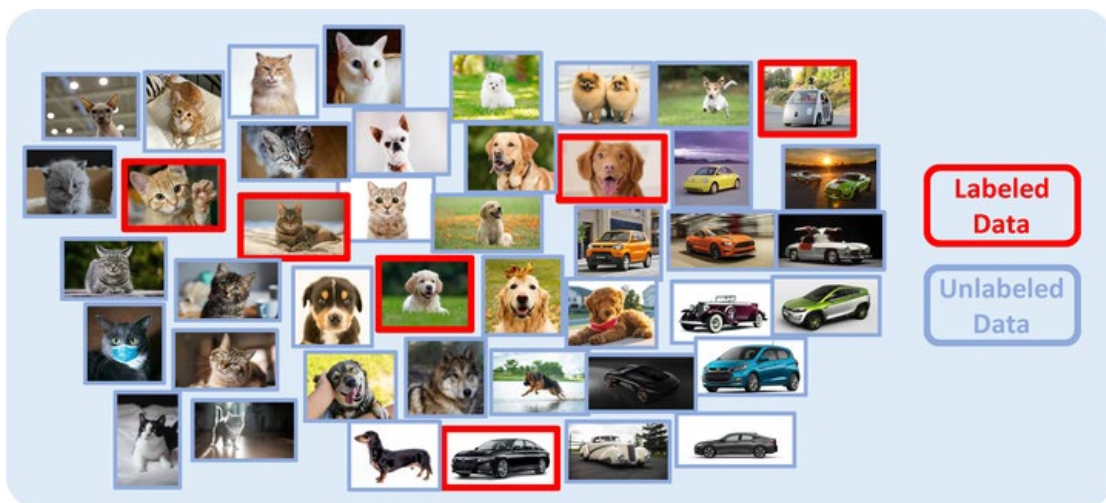
# Learning to Learn and Adapt with Less Labeling

**Description:** This project aims to make the process of training machine learning models more efficient by reducing the amount of labeled data required to build a model by six or more orders of magnitude, and by reducing the amount of data needed to adapt models to new environments by tens to hundreds of labeled examples. In order to achieve the massive reductions of labeled data needed to train accurate models, we focus on two technical objectives: to develop learning algorithms that learn and adapt efficiently; and formally characterise machine learning problems and prove the limits of learning and adaptation.

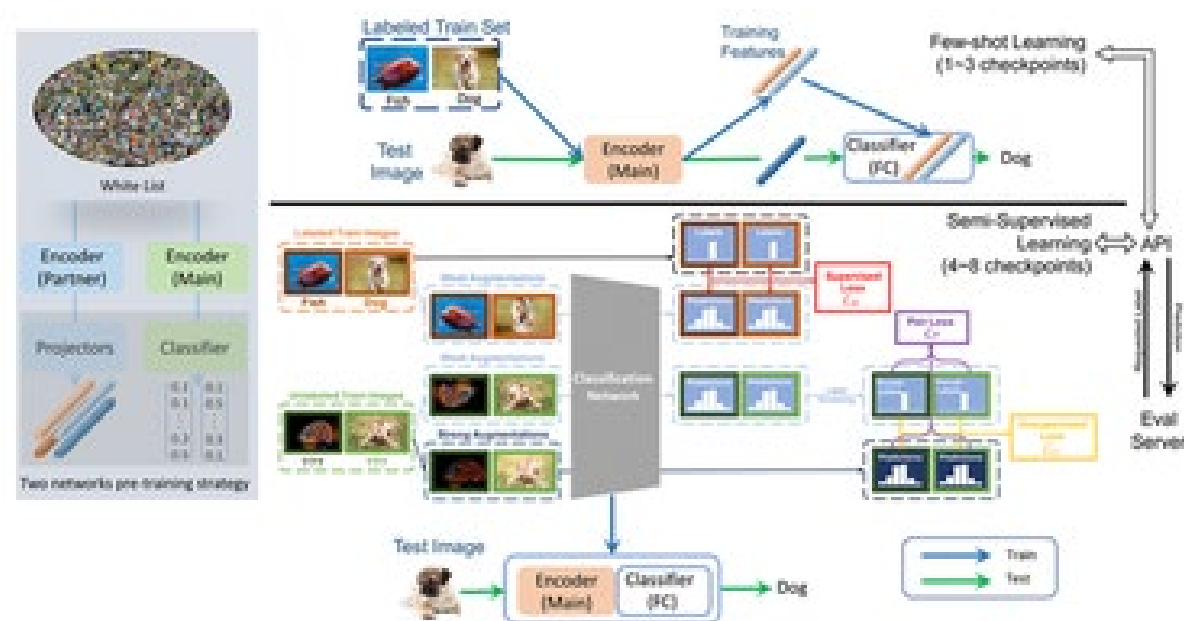
**Industry Partner:**

**The Defense  
Advanced Research  
Projects Agency  
(DARPA).**

Learning to learn with less labelling



Learning to learn with less labeling evaluation model pipeline





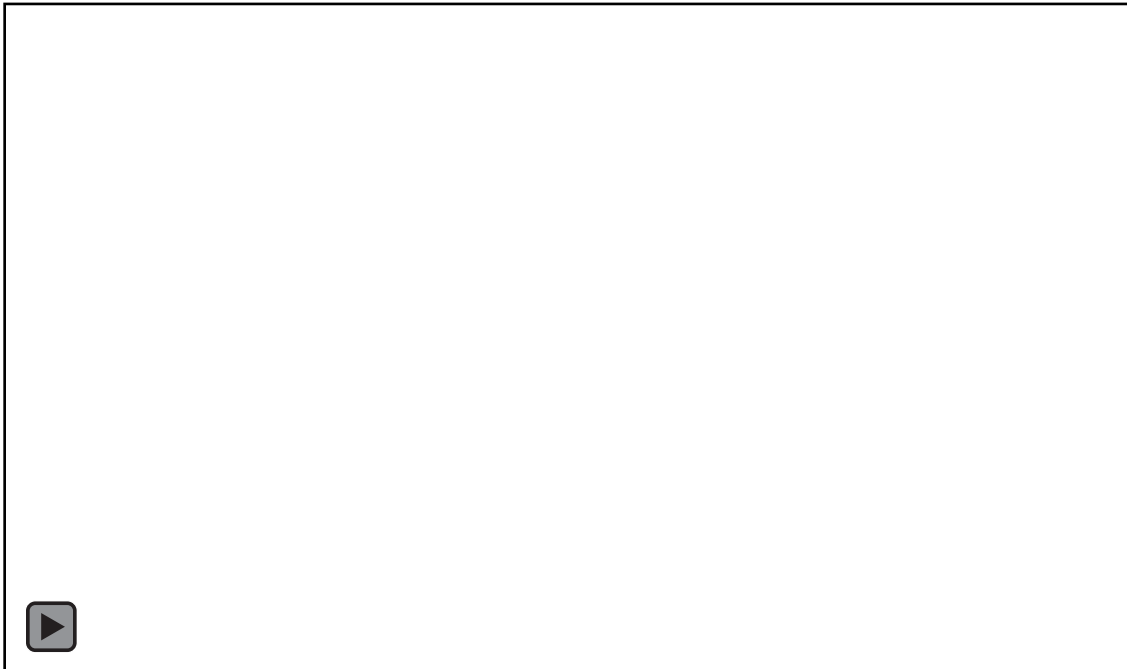
# 3D Event Reconstruction with Camera Localisation

**Description:** This 3D event reconstruction and analysis system, enabled by established machine learning techniques and physics models, can show synchronised videos from social media that capture an event in 3D space. This system brings together a variety of capabilities we have developed over the past few years (including video synchronisation and geolocation to order unstructured videos lacking metadata over time and space) to enable the reconstruction and analysis of events captured in videos.

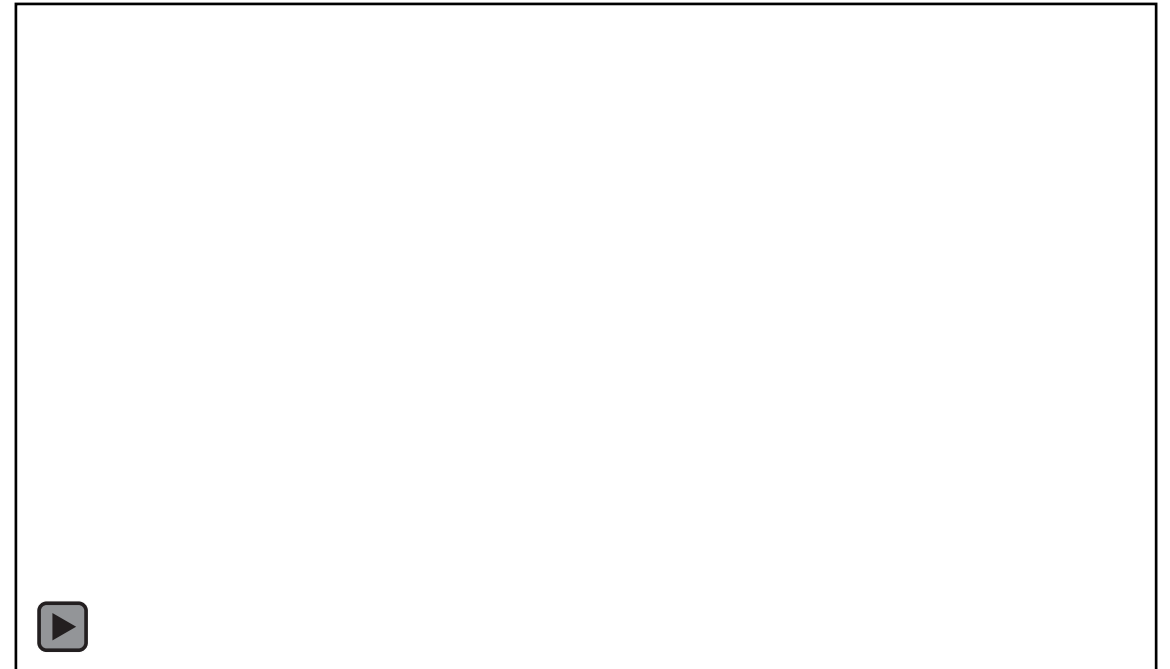
**Industry Partner:**

**National Institute of  
Standards and  
Technology (US).**

3D Reconstructed from Google Street View data



Camera Localisation in 3D Space



**Description:** This project aims to develop an intelligent bibliometric system *BiblioEngine* to analyse large-scale scientific literatures on precision medicine in obstetrics and gynaecology, and also to create key inputs for 23Strands' bioinformatics pipeline to generate insightful reports.

## 23Strands.

