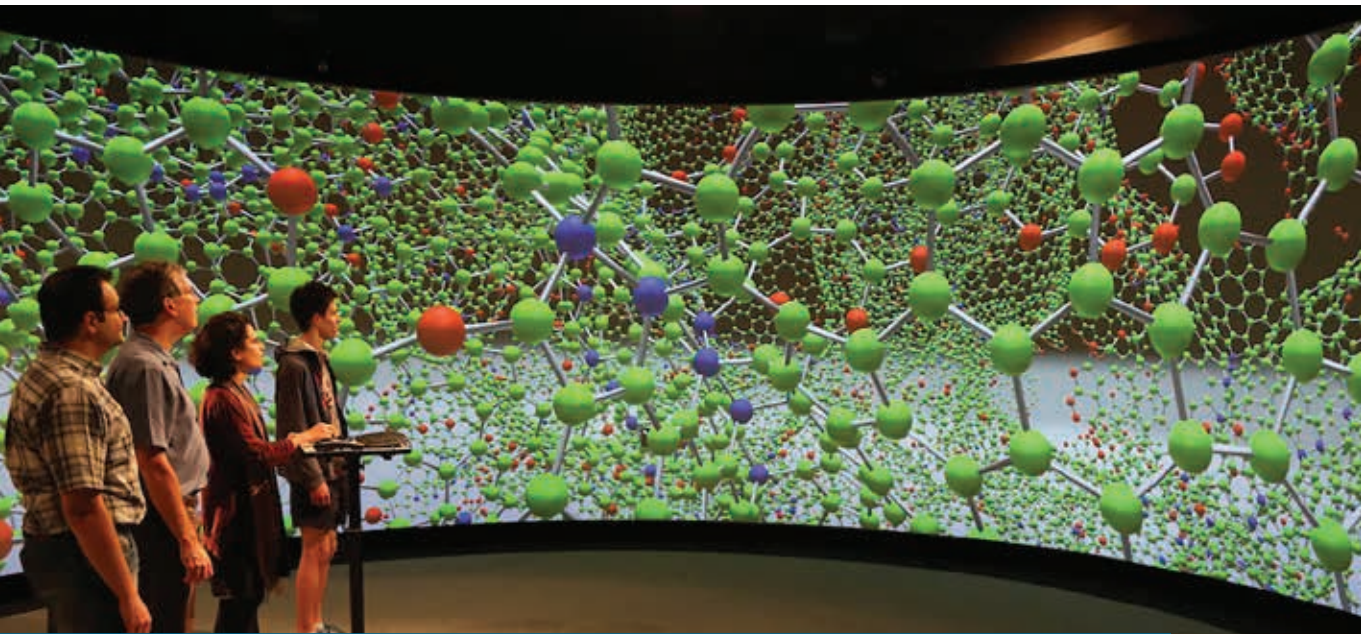




Curtin University



# CURTIN INSTITUTE FOR COMPUTATION

PERTH, WESTERN AUSTRALIA

BIG DATA ANALYTICS | SIMULATION  
MODELLING AND OPTIMISATION | VISUALISATION | EDUCATION

Make tomorrow better.

[computation.curtin.edu.au](http://computation.curtin.edu.au)



CIC specialists collaborate with researchers, government and industry partners in applying computational methods across the sciences, engineering, social sciences, health science, business, and the humanities to provide innovative solutions to complex problems.

## WORKING TOGETHER TO ADVANCE RESEARCH

The Curtin Institute for Computation (CIC) was founded to meet the growing demand for computational expertise. With all four faculties of Curtin University contributing to the CIC, expertise in computational modelling, data analytics and visualisation can now be applied to a multitude of Curtin research projects across all disciplines.

Research challenges, and ideas about how to solve them, can come from any field of human endeavour. The synergies, insights and operational breakthroughs come when CIC data scientists work with discipline experts to focus the power of computational methods on their discipline-specific challenges. Through participating in research projects that require advanced data science techniques, the CIC is increasing the speed of research, opening new avenues of inquiry, creating new possibilities and helping collaborators rapidly build on advances in numerous disciplines.

Working together, the pathway from real-world problems to solutions and impact can be fast-tracked. The benefits of working with the CIC have been realised by nearly 200 members of Curtin's academic community, as well as representatives from 59 government and industry partners, in the first four years of the CIC's existence. Through enabling data-driven research, the CIC has also played a significant role in attracting over \$20 million to Curtin over the past two years.

[curtin.edu/CIC](http://curtin.edu/CIC)

## COMPUTATIONAL CAPABILITIES

The CIC consolidates research capability and focuses on solving real-world problem across five themes:

**Big data analytics:** developing new ways of processing data when data sets are so large and complex that traditional data analysis techniques break down.

**Simulation:** using supercomputing to solve complex numerical models built to simulate a variety of dynamic systems, especially those of industrial significance.

**Modelling and optimisation:** developing mathematical models to describe the behaviour of physical systems, and optimising the parameters of the model to improve system performance.

**Visualisation:** improving data usability and interpretation to gain insights into research questions, by displaying and interacting with graphic representations of data or virtually-simulated environments.

**Education:** building computational skills through the integration of relevant units into undergraduate curricula, a targeted PhD program, providing seminars, training and workshops, and research to improve future digital learning and content delivery technologies.

The CIC is also a nucleus for the development of new capabilities, as the possibilities afforded by machine learning and artificial intelligence are explored.

Developing computational research capability, although a major focus of the CIC, leads to impact primarily through that expertise being harnessed to help attack broader research problems across other fields. Through the CIC and its team of data scientists, research collaborators can gain access to these capabilities, as well as state-of-the-art research infrastructure at:

### CURTIN HIVE (HUB FOR IMMERSIVE VISUALISATION AND ERESEARCH)

Curtin HIVE is serving the growing demand of researchers and industry for visualisation, virtualisation and simulation capabilities. Its four large-scale immersive and interactive systems enable new and improved capabilities in the interpretation, presentation and communication of research data.

[curtin.edu.au/hive](http://curtin.edu.au/hive)

### PAWSEY SUPERCOMPUTING CENTRE

The Pawsey Supercomputing Centre is a world-class facility that provides high performance computing resources to accelerate Australian scientific research. It is home to several supercomputers and supports an expanding network of users with supercomputing, data management, cloud and visualisation services.

[pawsey.org.au](http://pawsey.org.au)



Visualising the results of crater detection algorithm of Mars at the HIVE



CIC specialists visiting the Pawsey Supercomputing Centre



The CIC is working with Professor Kay O'Halloran and her team to track how extremist communications are spread and endlessly reinterpreted on the web.

## IDEAS, ENABLED

### VIOLENT EXTREMIST COMMUNICATIONS AND THEIR UPTAKE IN THE MEDIA

**Challenge:** Tracking and analysing extremist propaganda, and monitoring how these communications are recontextualised and repurposed over time, is becoming an insurmountable task in an age of online communication.

**Solution:** Automated natural language processing, computer vision and machine learning were employed to scrape the web, identify and classify content.

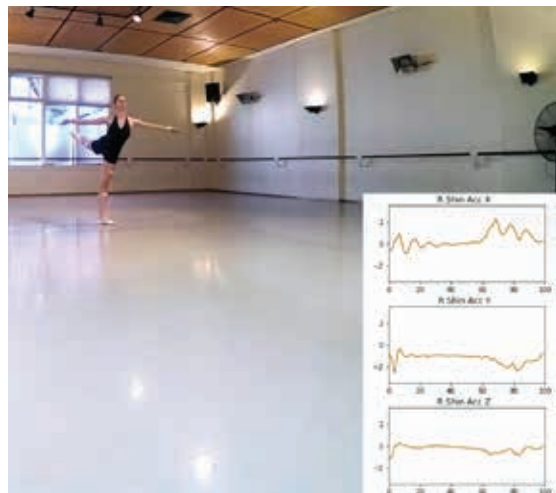
**Outcome:** Patterns developing between the original extremist propaganda, its uptake and spread, and its repurposing over time were identified, informing the development of strategies to counter it.

### MONITORING BALLET MOVEMENT FOR INJURY MANAGEMENT

**Challenge:** Monitoring ballet dancers to better manage fatigue and overload injuries requires better identification of specific movements than step counters, GPS trackers or smart watches can provide.

**Solution:** Data from wearable sensors were manually cross-referenced against video footage to build up a 'library' of sensor data matched to specific movements. A neural network was then trained with this library to automatically identify target movements from sensor data only.

**Outcome:** The trained neural network is being used to quantify the amount of jumping and leg-lifting training volume in 52 different dancers and track this load against incidences of pain and disability.



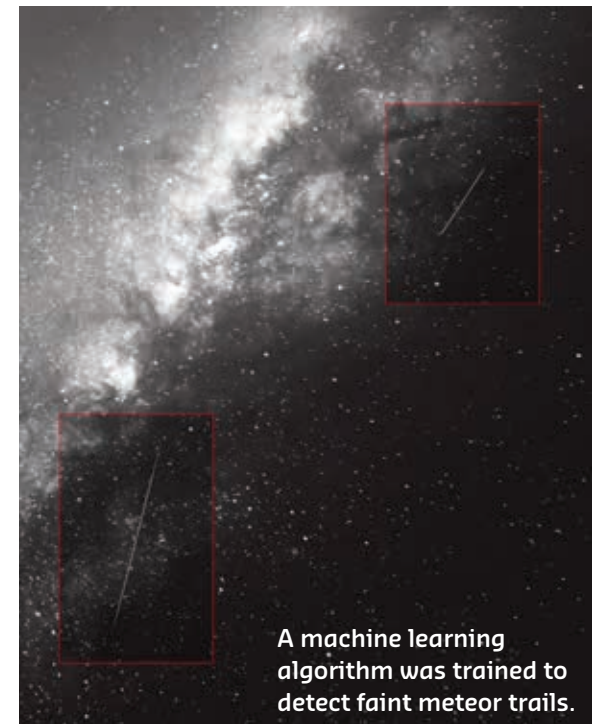
A machine learning model was developed to identify ballet movements for monitoring load and managing injuries

### FINDING FAINT FIREBALLS IN THE DARK DESERT SKY

**Challenge:** Correlating meteor sightings against their characteristic radio emissions is only possible if you can first find these rare meteor trails in the thousands of digital images taken of the night sky.

**Solution:** A machine learning algorithm was trained to identify meteor trails using a set of artificial training images created by adding random lines of varying thicknesses, lengths and light intensities onto images of the night sky.

**Outcome:** The algorithm is sifting through years of accumulated digital images and identifying meteor trails to compare against radio emissions recorded at the same time and location. Automating feature detection in the optical data and correlating with radio data is allowing radio astronomers to study transient events from meteors to space junk re-entering the atmosphere.



A machine learning algorithm was trained to detect faint meteor trails.

### BETTER BUSINESS DECISIONS TO MAXIMISE HARVEST PROFITS

**Challenge:** For grain farmers, choosing the right combination of harvest, storage and distribution pathways to optimise the value of their crop is complicated by inter-related and time-dependent variables.

**Solution:** An algorithm was constructed to capture the characteristics of a harvest season and the storage and transport activities associated with it. Variables included the area cropped, cost of storage, harvesting conditions, market price, transport and distribution. This algorithm was then integrated into a robust modelling tool for farmers.

**Outcome:** The model can calculate the expected costs and profits arising from particular harvest choices and conditions, allowing grain growers to run 'what if' scenarios to support decision making.



Farmers can make more informed decisions at harvest time using CIC-developed software.

# COMPUTATIONAL SUPPORT FOR RESEARCH GROUPS

Many research centres and institutes at Curtin closely collaborate with the CIC.

## CURTIN INSTITUTE OF RADIO ASTRONOMY (CIRA)

CIRA covers a wide range of radio astronomy projects, including aspects of next-generation telescopes such as the Murchison Widefield Array, and plays a key role in the preconstruction of the Square Kilometre Array – the world’s most powerful radio telescope and the ultimate big data challenge.

[astronomy.curtin.edu.au](http://astronomy.curtin.edu.au)

## CURTIN UNIVERSITY SUSTAINABILITY POLICY INSTITUTE (CUSP)

Sustainability across the range of human endeavour is becoming a key issue in public policy theory and practice. The CUSP Institute provides a multidisciplinary approach to increasing sustainability, focusing on reducing the human planetary footprint while improving quality of life for all. From climate change adaptation to smart cities, sustainability issues are increasingly multidimensional and data-driven.

[sustainability.curtin.edu.au](http://sustainability.curtin.edu.au)

## FUTURE OF WORK INSTITUTE (FOWI)

The FoWI promotes productive and meaningful work as essential foundations of a healthy economy and society. In a time of transition to a knowledge economy, FoWI seeks to understand and improve work opportunities, to support thriving people and organisations in the digital age.

[campaign.curtin.edu.au/future-of-work-institute](http://campaign.curtin.edu.au/future-of-work-institute)

## HEALTH RESEARCH AND DATA ANALYTICS HUB

The Hub aims to improve health outcomes and health service delivery in Western Australia through the effective application and integration of skills in clinical trials conduct, data capture and management, data linkage and analytics, digital health, and health systems and health economics research.

[curtin.edu/hrdah](http://curtin.edu/hrdah)

# UNDERPINNING NEW INITIATIVES

CIC capability is key to the development of several major initiatives hosted at Curtin University. The foundations provided by its data science team will be critical to the growth of these ventures into the future.

## INNOVATION CENTRAL

Innovation Central Perth is a collaborative community developing ingenious solutions for cloud, analytics and Internet of Things network platforms. It brings together start-ups, industry experts, developers and researchers in an open environment to create ground-breaking and innovative solutions through rapid prototyping and proofs-of-concept to solve real business problems.

[icentralau.com.au/Perth/](http://icentralau.com.au/Perth/)

## ARC TRAINING CENTRE FOR TRANSFORMING MAINTENANCE THROUGH DATA SCIENCE

This Industrial Transformation Training Centre will prepare the next generation of data scientists for Australia’s resources sector. Leveraging the explosive growth of data collection in the sector, the engineers of today and tomorrow will be equipped with the skills to deliver next generation data science methods for the maintenance sector in the resources industry.

[maintenance.org.au](http://maintenance.org.au)

## DATA SCIENCE INNOVATION HUB

Every industry sector has the potential to use the increasing availability of large volumes of complex data to grow, but data science capability is pivotal to being at the forefront of digital disruption. The Hub will help start-ups and SMEs access specialist data science capabilities in universities and other research organisations, and improve the translation of data science capabilities from the resources sector to emerging sectors.

[curtin.edu/wa-dsih](http://curtin.edu/wa-dsih)

## OPTUS-CURTIN CENTRE OF EXCELLENCE IN ARTIFICIAL INTELLIGENCE

Created through an alliance between Optus Business and Curtin University, the centre will bring together the experience and expertise of both industry and academia in an artificial intelligence research group focusing on the application and impact of artificial intelligence on regional telecommunications, higher education and the urban environment.



CUSP Renew Nexus project members discussing the future digitisation of housing in the City of Fremantle.



The Curtin Institute for Computation is co-located with Innovation Central Perth.

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