



Curtin University

A detailed 3D molecular simulation background showing a complex network of atoms and molecules. The atoms are represented by spheres in red, white, green, and brown, connected by bonds. The molecules are arranged in a dense, interconnected structure, with some larger, more prominent molecules in the foreground and smaller ones in the background. The overall appearance is that of a sophisticated computational model of a molecular system.

CURTIN INSTITUTE FOR COMPUTATION

PERTH, WESTERN AUSTRALIA

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

Make tomorrow better.

computation.curtin.edu.au



ABOUT CIC

Globally, computation is underpinning the majority of competitive research. As demand has grown, so too has the need for a dedicated institute.

The Curtin Institute for Computation (CIC) was founded to meet this increasing demand for computational modelling, data analytics and visualisation. The institute was formed by combining and expanding on the foundation laid by two former centres: the Centre for Process Systems Computation and Curtin Industrial Modelling and Optimisation.

The CIC initiates and fosters collaborative, interdisciplinary research and education programs that apply computational methods across computing; engineering; and physical, health and social sciences to provide innovative solutions to complex problems. It builds on the significant investments made by Curtin and its partners in the Square Kilometre Array (SKA) project and the Pawsey Supercomputing Centre, and complements activities within major research centres and institutes at the University.

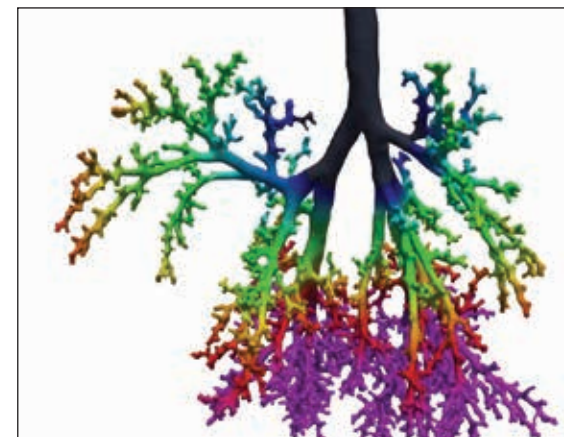
Industry will also play an important role within the institute, with a key focus on creating practical applications for computational technology. The Cisco Internet of Everything Innovation Centre at Curtin will facilitate this work, providing a hub where CIC researchers, industry and entrepreneurs can work together to accelerate innovation in next-generation technologies.

Importantly, the institute recognises Curtin's expertise in computation, supported by its access to powerful supercomputing resources. And with all four faculties of the University contributing to the institute, this expertise can now be applied to a multitude of research endeavours – a crucial move in a world where computation is an increasingly essential aspect of solving theoretical and applied research problems.

RESEARCH EXPERTISE

The CIC is focused on solving real-world problems across the following five themes:

- big data analytics
- education
- modelling and optimisation
- simulation
- visualisation.



BIG DATA ANALYTICS

Big data refers to data sets that are so large or complex that traditional data analysis techniques are not suitable and new ways of processing the data are required. Big data analysis is critical for next-generation radio telescopes such as the Murchison Widefield Array and the Australian component of the SKA.

EDUCATION

The CIC aims to build computational skills across the entire university community through a targeted PhD program, as well as the integration of related units into undergraduate curricula across all faculties. In addition, research into learning sciences and computational approaches feeds into future learning and content delivery technologies that continuously improve the University.



MODELLING AND OPTIMISATION

Modelling and optimisation researchers develop mathematical models to describe the behaviour of a physical system and then optimise the parameters of the model to improve the performance of that system. Curtin researchers are using these techniques to improve the efficiency of the agriculture, mining, defence, communications and transport industries.

SIMULATION

Simulation uses supercomputing to solve complex numerical models, particularly those that have to be evaluated many times to generate dynamic information. The CIC has a great depth of expertise in molecular modelling, computational fluid dynamics and finite elements. These techniques are used to precisely simulate a variety of systems, especially those of industrial significance.

VISUALISATION

CIC researchers working within this theme seek to gain insight into research questions by displaying and interacting with representations of data or virtually simulated objects and environments on large, immersive displays. These projects typically require expertise in computer science, usability and interaction design. CIC researchers can use the Curtin HIVE (Hub for Immersive Visualisation and eResearch), with its four large-scale immersive and interactive systems.

WHY CURTIN?

Curtin's research profile is growing, with the University leaping more than 180 places in the Academic Ranking of World Universities over the past two years, largely due to powerful research collaborations. The University is now placed in the top 2 per cent of universities worldwide. These collaborations, with academia, industry, government and community, will aid your research and can result in outcomes that greatly benefit the broader community locally, nationally and globally.

FACILITIES AND RESOURCES

We understand that to undertake high-quality research, staff and students need access to high-quality research infrastructure. To this end, Curtin has invested in enhanced learning environments, increased access to state-of-the-art technology, and research spaces that respond to the changing needs of industry.

Our national reputation for computation is driven by supportive infrastructure that includes access to high-level supercomputing systems through the Pawsey Supercomputing Centre.

The institute also complements research activities within several major centres and institutes at Curtin, including:

CURTIN HIVE

Curtin HIVE (Hub for Immersive Visualisation and eResearch) is an advanced facility established to serve the growing demands of researchers and industry for visualisation, virtualisation and simulation capabilities in Western Australia.

Nationally and internationally, data collection is becoming more intensive. Sensor technologies are improving in quality and capacity, delivering a dramatic increase in data volumes. Curtin HIVE enables a new and improved capability in the interpretation, presentation and communication of research data.

curtin.edu.au/hive

CURTIN INSTITUTE OF RADIO ASTRONOMY

The Curtin Institute of Radio Astronomy concentrates its research effort into a range of radioastronomy projects and plays a key role in the preconstruction of the SKA – the world's most powerful radio telescope and the ultimate big data challenge.

astronomy.curtin.edu.au



NANOCHEMISTRY RESEARCH INSTITUTE

The Nanochemistry Research Institute focuses on the study of nanoparticles and nanostructures. The nature of this research demands a multidisciplinary approach, with projects involving a combination of chemical synthesis, characterisation and computer simulation.

nanochemistry.curtin.edu.au

INSIGHT CENTRE FOR LEARNING ANALYTICS

Curtin Learning & Teaching hosts this cross-functional team of researchers and analysts and supports researchers with interests in higher education and learning sciences. The team has access to all data produced by students and teachers in the University. Typical methods include self-organising maps, symbolic regression and cluster analyses to address questions concerning all aspects of learning and teaching.

PAWSEY SUPERCOMPUTING CENTRE

The Pawsey Supercomputing Centre is a purpose-built facility named after Australian radio astronomy pioneer Dr Joe Pawsey. An unincorporated joint venture between the four WA public universities and CSIRO, the Pawsey Centre hosts multiple supercomputers, cloud resources, data-intensive machines and storage systems to support computational research. The centre is home to the petascale supercomputing system 'Magnus', which debuted in the Top500 list in 2015 as the most powerful public research supercomputer in the Southern Hemisphere.

pawsey.org.au

COLLABORATION WITH PEOPLE AND INDUSTRY

CISCO INTERNET OF EVERYTHING INNOVATION CENTRE

The Western Australian node of Cisco's new Internet of Everything Innovation Centre is hosted by Curtin, with the support of foundation partner Woodside.

One of eight globally, the centre aims to catalyse innovation and development, bringing together start-ups, industry experts, developers, customers, government organisations and researchers in an open environment to create a 'connected community' focused on cloud, big data analytics, cybersecurity and IoE network platforms.

The centre, which includes a state-of-the-art laboratory, a technological collaboration area and an IoE demonstration space, will initially focus on research in radio astronomy, resources, agriculture and the smart campus.



CASE STUDIES

OPTIMISATION: MINIMUM-COST VESSEL SCHEDULING FOR OFFSHORE OIL AND GAS PRODUCTION IN THE NORTH WEST SHELF

CHALLENGE

To determine the optimal routes by which support vessels should visit offshore oil and gas facilities in order to minimise operating costs.

SOLUTION

- Mathematical models for generating optimal vessel routes in any operating scenario.
- Visit schedules that optimise time and fuel consumption while ensuring that all cargo delivery and offtake requirements are completed.

OUTCOME

- Best vessel routes and schedules determined, providing the optimal fleet replacement strategy.
- Reduction in current fleet from four to three vessels, with a cost saving of \$10 million per year.
- Automated vessel scheduling tool currently in development.

SIMULATION: DESIGNING AND PREDICTING PERFORMANCE OF GAS/OIL SEPARATION FILTERS

CHALLENGE

To create a computational model that predicts the performance of gas/oil separation filters, enabling an alternative design process to the previous 'trial and error' or empirical approach.

SOLUTION

- Develop a computational model that validates well against experimental data.
- Allow for an optimisation of filter design and prediction of filter performance.

OUTCOME

- Reduction of the time required to test a filter design (compared to lab tests), by about a factor of 5 (at present), resulting in a reduction of cost.
- Enabled the development of improved filter/separator designs that have increased capture efficiency, lower pressure drop and reduced re-entrainment/carry-over.

DATA ANALYTICS: OPTIMISING ELECTRICITY CONSUMPTION AT REMOTE SITES

CHALLENGE

To reduce electricity consumption, and therefore cost, by optimising air-conditioning usage at a remote mining accommodation site in Karratha where electricity is generated using diesel-powered generators.

SOLUTION

- Develop a system that automatically switches off the air-conditioning when occupants of single person quarters (SPQ) go to work and switch on half an hour before the arrival of the cleaners and/or the return of the occupant.
- Develop sensor-based monitoring to track departures of occupants staying in SPQ, and use rosters to estimate the arrival of occupants and cleaners.

OUTCOME

- Significant reduction in the reliance on the generators, resulting in increased savings through lower diesel consumption and, subsequently, reduced transportation of diesel to the site.
- SPQ occupants did not experience any change in their lifestyle.



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