

# Centre for Smart Analytics (CSA)





# Smart solutions for smarter, more resilient communities and industries

The Centre for Smart Analytics (CSA) brings together expertise from across Federation University and its partner organisations.

These multidisciplinary teams are working to develop new knowledge and innovative solutions to the grand challenges of smart and resilient cities, regions and industries – solutions that positively impact lives and communities, both nationally and internationally.

CSA's research activities include:

- supporting smart cities, regional ecosystems and the Australian Government's digital economy strategy to secure sustained prosperity, employability and improved liveability
- managing optimised use of water, energy and natural resources to help Australia's businesses and agriculture stay globally competitive and protect the environment
- safeguarding Australia's critical infrastructure and essential services against external and internal cyberattacks
- exploring next-generation education systems to equip students for future challenges and opportunities
- understanding the impact of changing demography, environment and globalisation, and engaging more actively with industries and government for novel solutions and policymaking

Digital technology is the key enabler for secured, sustained and growth-focused socio-economic systems. Relentless innovation and continual research will be required to find solutions that ensure smart living and education for citizens, provide breakthrough technology solutions, support the Australian government's digital economy strategy, lift global competitiveness, boost industrial productivity, strengthen national security and address societal challenges.

CSA collaborates with regional communities, government and industry partners and researchers from national and overseas research organisations. In particular, it leverages its strong existing and emerging research collaboration opportunities with IBM and City Councils of Casey, Ballarat, Grampians and the Wimmera and Latrobe Valley. It works closely with the state and commonwealth governments and contributes to national capacity building through various initiatives.

## CSA'S RESEARCH STREAMS

CSA's objectives are aligned with its five research streams:

### SUSTAINABLE SMART CITIES AND REGIONS

This stream identifies and prioritises 'smart' services that will benefit cities or regions and optimises the computing infrastructure design to deliver them, while advancing national AI capabilities.

### SECURING AUSTRALIA'S CYBERSECURITY LANDSCAPE

This stream predicts and detects security breaches and responds to and recovers from incidents via security capabilities informed by threat intelligence.

### COMPUTATIONAL AND INTELLIGENT MATHEMATICS

This stream applies optimisation methods and approaches to model and solve real-world problems in machine learning, artificial intelligence, bioinformatics and finance.

### KNOWLEDGE-BASED SMART BUSINESS

This stream focuses on supporting businesses to improve their knowledge competencies and capabilities through applied workplace learning and research.

### RESILIENT EDUCATION SYSTEMS

This stream seeks to equip students for meeting future challenges in a changing world by examining teaching approaches and practices and inventing new technologies for smart learning experiences.



# Research with **real-world impact**

Our focus is on applied research that makes a difference in the communities we serve. The following case studies present just some examples of how this Centre's research is having a positive impact in the world.



## Case study: Using maths to combat malware

The number of challenging problems that rely on maths to find a solution is growing all the time.

A Federation University Australia researcher is using complex mathematics to help in the battle against cybercrime, teaming up with the University's Internet Commerce Security Lab (ICSL) to develop algorithms that can detect malware in computer systems and networks.

Professor of Applied Mathematics, Statistics and Optimisation, Adil Baghirov, who was awarded an Australian Research Council Discovery Grant, is also developing new methods to solve large problems across different sectors, including water management systems and in artificial intelligence.

Malware, or malicious software, is used by criminals to steal information, money, or a computer's resources, and can attack computers and networks in several ways. These include trojan programs, ransomware – which can make a computer unusable until a fee is paid – keyloggers and viruses, according to the Australian Cyber Security Centre.

A key component of the work is to deploy data mining and artificial intelligence techniques to detect abnormal online behaviour. This could include everyday online banking transactions.

The rate of cybercrime continues to accelerate across the world, with online attacks ranging from those targeting individuals to highly sophisticated attacks on large corporations and governments. The global pandemic has also increased the risks for many people who migrated from their offices to work from home, in some cases with their own IT equipment that may have been vulnerable to an attack.

Professor Baghirov said the challenge for cybersecurity experts has been to stay ahead of the criminals. He said the most common feature of these attacks was that they were all different to 'normal' online behaviour.

Professor Baghirov said the number of challenging problems that relied on complex optimisation to find a solution was growing all the time.

## Case study: Researchers develop blockchain traceability tech for grain exports

Researchers at Federation University's new Centre for Smart Analytics are developing technologies that could be a game-changer for Australia's grain export supply chain.

The researchers are developing digital traceability processes to assess the quality of grains, including wheat, barley and sorghum, tracing the grains from when they are grown on a farm through to the end user. Traceability systems show international consumers that products are safe, clean and sustainable.

Associate Professor Shyh Wei Teng, who is a multimedia analytics specialist and is leading the project, said digital traceability technology was quickly gaining attention in food industries, but there had been little work on this in the Australian grain export supply chain.

Professor Manzur Murshed, whose research interests include image and video processing and machine learning, said the technology would introduce non-invasive sampling techniques into the supply chain, eliminating some time-consuming processes requiring samples to be analysed in a lab.

Professor Murshed said the process could involve someone taking a handful of grains from a batch and throwing it downward in front of specialised camera equipment that would reveal moisture content, any impurities in the grains, and any damage to the grains – among other things.

Associate Professor of Cyber Security Paul Pang will lead the project's blockchain development. Blockchain, which is best known as the technology behind leading cryptocurrencies, will be a key component of the technology used in the project.

The project is being funded by the Department of Agriculture, Water and the Environment's National Traceability Project, a \$68 million program to improve traceability systems and increase access to premium overseas markets.

Professor Murshed said the research team aimed to develop a prototype that will be adopted by Standards Australia and the major grain exporters.

Federation is collaborating with Grain Trade Australia, IBM, and The Chinese Academy of National Food and Strategic Reserves Administration.

# Centre Leadership

CSA has two centre co-directors as well as leadership teams for each of its research streams.



**Professor  
Joarder Kamruzzaman**

CO-DIRECTOR  
CENTRE FOR SMART ANALYTICS

Professor Joarder Kamruzzaman is an internationally recognised computer scientist specialising in sensor networks, Internet of Things, machine learning and cybersecurity. Combining expertise in these areas, his endeavour is to develop smart and secured technologies that benefit society.

During 2008-2014, Professor Kamruzzaman served as the Director of the Centre for Multimedia Computing, Communications and Artificial Intelligence Research hosted first by Monash University and later by Federation University, and as the Co-Director of Research at Monash University's Gippsland campus (2009-10).

Professor Kamruzzaman has published over 290 articles in top-tier journals and conferences in his field. He is the recipient of the Best Paper award in four international conferences: International Conference on Information and Communications Security 2015, Singapore; Asia-Pacific Conference on Communications 2014, Thailand; Institute of Electrical and Electronics Engineers (IEEE) Wireless Communications and Networking Conference 2010, Sydney; and in the IEEE International Conference on Neural Networks and Signal Processing, Nanjing China. He was also awarded his school's Researcher of the Year Award twice (2016, 2022) and Graduate Research School Award for Excellence in Graduate Research Supervision (2019) at Federation University.

Professor Kamruzzaman has received over \$2.6 million competitive research funding, including highly prestigious Australian Research Council grant, large Collaborative Research Centre grant and many industry/government funded grants. He was the founding Program Co-Chair of the IEEE International Conference on Dependability in Sensor, Cloud, and Big Data Systems and Applications and has served in a leadership capacity for many conferences. Since 2012, he has been an Editor at the Elsevier Journal of Network and Computer Applications and has guest-edited several special issues in reputed international journals.



**Professor  
Adil Baghirov**

CO-DIRECTOR  
CENTRE FOR SMART ANALYTICS

Professor Adil Baghirov is Professor of Applied Mathematics, Statistics and Optimisation at Federation University.

Professor Baghirov's main research interests are in the area of non-smooth and global optimisation and their applications in data mining, regression analysis and water management.

Professor Baghirov has published two books on non-smooth optimisation and its applications, and more than 150 research papers. Professor Baghirov has won five Australian Research Council Discovery and Linkage grants to conduct research in non-smooth and global optimisation and their applications. He has had research projects with several industry partners including Woodside Energy and GWMWater, which delivered tens-of-millions of dollars in benefit to industry.

Professor Baghirov has been with Federation University Australia since 1999. He received a master's degree in applied mathematics from Baku State University, Azerbaijan in 1983. He received the candidate of sciences degree in mathematical cybernetics from the Azerbaijan National Academy of Sciences in 1989 and a PhD degree in optimisation from the University of Ballarat (now Federation University Australia) in 2002.

In 2022, Professor Baghirov was appointed to the Australian Research Council's College of Experts, where he plays a key role in identifying and contributing to research excellence in Australia.

## Research Stream Leaders

### SUSTAINABLE SMART CITIES AND REGIONS

- Professor Manzur Murshed
- Professor Joarder Kamruzzaman

### SECURING AUSTRALIA'S CYBERSECURITY LANDSCAPE

- Associate Professor Paul Pang

### COMPUTATIONAL AND INTELLIGENT MATHEMATICS

- Professor Adil Baghirov

### KNOWLEDGE-BASED SMART BUSINESS

- Professor Andrew O'Loughlin

### RESILIENT EDUCATION SYSTEMS

- Associate Professor Robyn Brandenburg



## Find out more

For research queries and to find out more about CSA's research, visit the Centre website: [federation.edu.au/csa](https://federation.edu.au/csa)