

2019 EDITION



defence science institute
Creating Defence Science Research Networks for Australia

VICTORIAN
DEFENCE & AEROSPACE
RESEARCH CAPABILITY





**Deakin University's
Universal Motion Simulator (UMS).**

Foreword

Victoria leads the nation in advanced research, development and innovation.

Our state's universities contribute almost a third of Australia's university research and development (R&D) investment and twice as much as any other state to national university defence related R&D investment.

Our capabilities in areas such as advanced robotics, 3D printed explosives, high strength protective woven fabrics and enhanced radar detection and identification capabilities, are world-leading.

Now more than ever, as we reach unprecedented levels of investment in defence capabilities, there is a need for advanced research to address defence and national security challenges.

These challenges are inherently complex, and their solutions require government, industry and universities to work together.

With internationally renowned researchers and state-of-the-art facilities, Victoria's universities have much to offer those working on defence and national security matters.

The Victorian Government, in partnership with the Defence Science and Technology Group and the University of Melbourne, established the Defence Science Institute (DSI) to help government and industry identify the capabilities, expertise and potential solutions held in our universities that can be directed towards future priorities.

The DSI provides a single access point for all those who wish to make use of university resources, whether they be a small business, multinational corporations, the Commonwealth Government or one of our allies.

This directory provides an overview of many of the defence and national security-related research capabilities available within Victorian universities.

I commend the capabilities highlighted in this brochure and invite those seeking innovative solutions to complex defence and national security problems to consider partnering with Victoria's universities.

THE HON MARTIN PAKULA MP

Minister for Jobs, Innovation and Trade

Victorian Defence and Aerospace Research

The universities and research centres of Victoria are recognised internationally for their research and make a significant contribution to Australia's defence and national security research efforts. With research capabilities across an expansive range of disciplines and technologies, they are a vital resource for the Defence sector to draw on. Through their research activities, the universities and research centres also provide essential training for the Defence scientists of the future and are home to world class facilities.

Together, Victoria's universities and research centres form a community of practice which supports Defence priorities, both short- and long-term. They work closely with each other, and with industry and government, to share knowledge and expertise in pursuit of a secure future for us all.

Universities

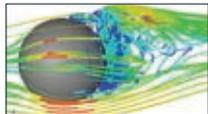


Research Centres



Victorian Defence and Aerospace R&D Capabilities

Victoria's universities and research centres have a proven research record in a wide range of discipline areas applicable to all aspects of Defence operations. Their capabilities and credentials are identified in this Directory against the broad capability areas outlined below.



Advanced Sensors & Processing

Technologies and tools to collect, send and analyse information from land, sea, air and space environments.



Big Data Processing & Visualisation

Tools and techniques for extracting and presenting meaningful information from big data sets to support effective decision making.



Cyber & IT Security

Technologies, tools and techniques ensuring network integrity and addressing threats arising from information and communications technology dependencies and vulnerabilities.



Enhanced Human Performance & Protection

Techniques, technologies and therapies to save lives, reduce injuries, promote resilience and improve performance in moderate and extreme environments.



Hypersonics & Directed Energy Capabilities

Materials and technologies for future directed energy capabilities, propulsion, dynamics, and control surfaces to support hypersonic systems in air, space and sea.



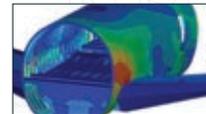
Integrated Intelligence, Surveillance & Reconnaissance

Technologies, tools and techniques for effective enterprise intelligence, surveillance, reconnaissance integration and interoperability.



Medical/Pharma Technologies

Tools, technologies and products to protect from a range of chemical, biological and radiological threats, pandemics and emerging infectious diseases.



Modelling, Simulation & Analysis

Live, virtual and constructive simulation, modelling and analysis tools for use in operations, training, design, scenario development, risk analysis and forecasting.



Multi-Disciplinary Material Sciences

Materials and processes to support advanced manufacturing, enhance operational longevity, reduce platform detection and improve ballistic and shock protection.



Propulsion & Energy Storage

Tools and technologies for increased efficiency, performance and safety in propulsion and energy storage systems for land, sea, air and space use.



Quantum Technologies

Quantum-based sensor and computing technologies to increase security and improve the performance of communications and computing.



Space Systems

Materials, technologies and tools to design, build, launch, position, operate and safeguard satellite networks and communications.



Sustainment

Materials, tools, technologies and techniques supporting the ongoing operations and maintenance of all defence and aerospace assets and activities.



Trusted Autonomous Systems

Autonomous technologies and tools for high risk, difficult or remote tasks and increasing efficiency and operational flexibility.

	Trusted Autonomous Systems	Sustainment	Space Systems	Quantum Technologies	Propulsion & Energy Storage	Mult-Disciplinary Material Sciences	Modelling, Simulation & Analysis	Medical/Pharma Technologies	Integrated Intelligence, Surveillance & Reconnaissance	Hypersonics & Directed Energy Capabilities	Enhanced Human Performance & Protection	Cyber & IT Security	Big Data Processing & Visualisation	Advanced Sensors & Processing
Deakin University: Page 10	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging
Federation University Australia: Page 16	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging
La Trobe University: Page 20	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging
Monash University: Page 26	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging
RMIT University: Page 32	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging
Swinburne University of Technology: Page 40	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging
University of Melbourne: Page 44	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging
Victoria University: Page 52	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging
DMTC: Page 56	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging
Oceania Cyber Security Centre: Page 60	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging	Emerging

Capability Status





defence science institute

Creating Defence Science Research Networks for Australia

Defence Science Institute

The Defence Science Institute (DSI) supports the development of Victoria's defence technology and national security industry. Facilitating connections and relationships between industry, universities, funders and Defence researchers, the DSI helps the sector make use of the considerable talent found in our universities and research centres.

Supported by the State Government of Victoria and the Defence Science and Technology Group (Australia's defence research organisation), the DSI acts on behalf of Victorian universities to help them grow their contribution to defence research.

Taking a regional and multi-disciplinary approach to the defence and national security sector, the DSI focuses on fostering defence research engagement by:

- Connecting defence and industry to R&D expertise;
- Promoting and showcasing R&D and innovation capabilities in the public and private sectors;
- Identifying defence-relevant research and technology development opportunities; and
- Providing advice on the local and international defence research and development environment.

With strong links into universities, industry and government, the DSI provides a broad overview of defence-relevant capabilities, facilities and priorities, across Victoria and Australia. Practical support for engagement is provided through activities such as:

- Discovery workshops;
- Seed funding grants for collaborative research;
- Postgraduate student support grants;
- Industry internship grants for research students;
- Hosting of trade mission, funder and industry delegates;
- Training for and hosting of innovation pitches focused on investment; and
- Participation in major defence industry events.

Bringing together the capabilities of industry and government with academia, the DSI is committed to helping the sector find innovative solutions to defence problems.

www.defencescienceinstitute.com



PROVEN EXPERTISE – DEFENCE EXCELLENCE

Victoria leads Australia in innovation, new technologies, R&D and advanced manufacturing. Our defence sector is an important part of the state's economy, contributing up to \$8 billion annually. More than 20,000 men and women work across the sector in defence industry and the Australian Defence Organisation, and we have more than 400 businesses making equipment and providing services for defence activities.

One of the key pillars supporting Victoria's defence sector is its strength in R&D. The state has internationally recognised research institutes and organisations supported by a world class tertiary education sector.

In 2010, the Victorian Government underscored its support for the state's university-led defence R&D by establishing the Defence Science Institute in partnership with the Commonwealth Defence Science and Technology Group. The Defence Science Institute brokers the interface between industry and researchers, as well as leading a true community-of-practice among Victoria's eight universities, while bringing in best practice researchers from other geographies when needed.

Defence technology research is undertaken by Victoria's tertiary institutions, often in collaboration with Defence, industry and other national and international institutions. Melbourne, Monash, La Trobe, Deakin, RMIT, Swinburne, Victoria, Australian Catholic and Federation universities all have world class research capabilities.

Victorian universities contribute approximately 29 per cent (\$3.1 billion) of national university R&D spend and approximately 38 per cent (\$33.9 million) of national university defence R&D spend. It is one of Australia's leading states for graduates in disciplines underpinning the defence industry, including information technology, engineering and related technologies.

When UK investment giant Savill's released its 2017 rankings of the world's Top 20 Tech Cities, Melbourne was rated number 14 – the only Australian city to feature. And for a tech-savvy talent pool, Savill's ranked Melbourne fifth in the world. Victoria's competitiveness in fast-developing technologies is internationally recognised.

Global defence firms like Boeing and Lockheed Martin have chosen to locate significant R&D laboratories in Melbourne, drawing on the pipeline of expertise to be found here. Victoria also provides innovation leadership through a matrix of complementary hubs where research and industry interact, such as the Defence Materials Technology Centre, the CSIRO's Data61 Cyber Security and Innovation Hub and the Oceania Cyber Security Centre.

The Victorian Government has also secured agreements to work with global research powerhouses, including Oxford University's Global Cyber Security Capacity Centre, Israel's Tel Aviv University and the Commonwealth of Virginia, the biggest defence state in the US. Victoria's global outlook supports strong strategic alliances.

The Victorian Government, through the Department of Jobs, Precincts and Regions (DJPR), will continue to work closely with Victorian universities, the Commonwealth Department of Defence and defence industry to identify and support the development of new technologies to meet strategic defence industry capability requirements.

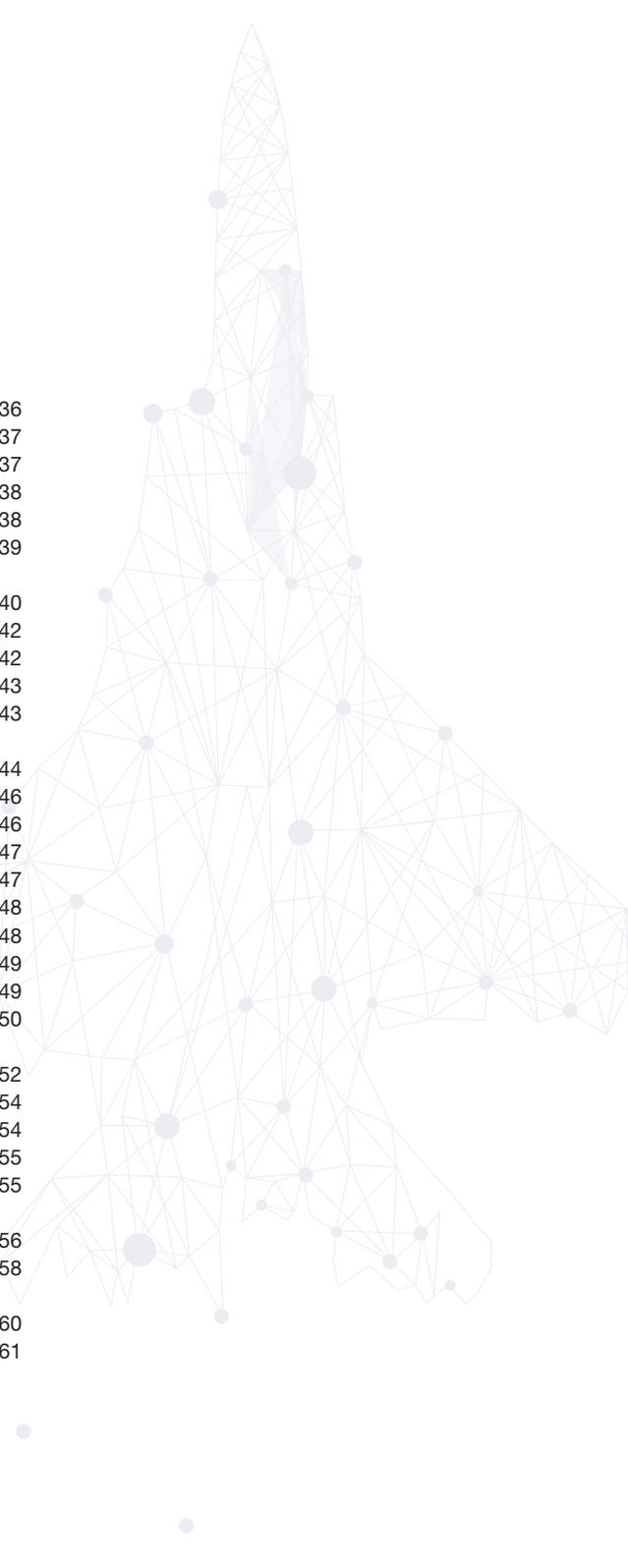
With proven expertise in delivering complex defence projects and recognised globally for innovation and world class defence industry capabilities, Victoria can make an important contribution to Australia's future defence needs.



Contents

	Trusted Autonomous Systems	Sustainability	Space Systems	Quantum Technologies	Propulsion & Energy Storage	Multi-Disciplinary Material Sciences	Modelling, Simulation & Analysis	Medical/Pharma Technologies	Integrated Intelligence, Surveillance & Recon	Hyperionics & Directed Energy Capabilities	Enhanced Human Performance & Protection	Cyber & IT Security	Big Data Processing & Visualisation	Advanced Sensors & Processing	
DEAKIN UNIVERSITY															10
Deakin University	•	•			•	•	•	•	•	•	•	•	•	•	12
Deakin University Institute for Intelligent Systems Research and Innovation (IISRI)	•								•	•	•	•	•	•	12
Deakin University Institute for Frontier Materials (IFM)		•			•	•	•	•	•						13
Deakin University Applied Artificial Intelligence Institute (A2I2)	•						•	•	•	•	•	•			13
Deakin University Cyber Security Research and Innovation Centre (CSRI)												•			14
FEDERATION UNIVERSITY AUSTRALIA															16
Federation University Australia	•	•				•	•	•	•	•	•	•	•	•	18
Federation University Australia Centre for Informatics and Applied Optimization (CIAO)	•	•									•	•	•	•	18
Federation University Australia Internet Commerce Security Lab (ICSL)	•						•	•				•	•	•	19
Federation University Australia Mechatronics and Reliability Engineering		•			•										19
LA TROBE UNIVERSITY															20
Latrobe University	•	•	•	•	•	•	•	•	•	•	•	•	•	•	22
La Trobe University AgriBio Research Centre								•			•				22
La Trobe University Centre for Technology Infusion (CTI)				•							•			•	23
La Trobe University Engineering & Mathematical Sciences	•	•			•	•	•	•	•	•	•	•	•	•	23
La Trobe University Sport & Exercise Medicine Research Centre (LASEM)								•			•				24
La Trobe Institute for Molecular Science (LIMS)								•			•			•	24
MONASH UNIVERSITY															26
Monash University	•	•	•	•	•	•	•	•	•	•	•	•	•	•	28
Monash University - Aerospace		•	•		•	•	•	•	•	•	•	•	•	•	28
Monash University Centre for Additive Manufacturing (MCAM)		•	•		•	•									29
Monash University Maintenance Technology Institute (MTI)		•			•	•					•				29
Monash University Biomedical and Pharmaceutical Sciences								•			•				30
Monash University Engineering	•	•	•	•	•	•	•	•	•	•	•	•	•	•	30
Monash University Information Technology	•						•	•	•	•	•	•	•		31
RMIT UNIVERSITY															32
RMIT University Sir Lawrence Wackett Centre	•	•	•	•	•	•	•	•	•	•	•	•	•	•	34
RMIT University - Aerospace Research	•	•	•	•	•	•	•	•	•	•	•	•	•	•	34
RMIT University - Autonomy & Automation	•	•					•							•	35
RMIT University - Biotechnologies, Human Performance & Protection	•							•		•					35
RMIT University - Data, Information & Communications			•	•			•	•			•	•			36

	Trusted Autonomous Systems	Sustainability	Space Systems	Quantum Technologies	Propulsion & Energy Storage	Multi-Disciplinary Material Sciences	Modelling, Simulation & Analysis	Medical/Pharma Technologies	Integrated Intelligence, Surveillance & Recon	Hyperionics & Directed Energy Capabilities	Enhanced Human Performance & Protection	Cyber & IT Security	Big Data Processing & Visualisation	Advanced Sensors & Processing	
RMIT University - Multifunctional Materials & Advanced Manufacturing															36
RMIT University - Remote and Embedded Sensors															37
RMIT University - Space Systems															37
RMIT University - Trans-Disciplinary Design and Virtual Prototyping															38
RMIT University - Transport, Infrastructure, Power & Energy															38
RMIT University - Workforce Skills Development															39
SWINBURNE UNIVERSITY OF TECHNOLOGY															40
Swinburne University of Technology															42
Swinburne University of Technology Data Science Research Institute (DSRI)															42
Swinburne University of Technology Manufacturing Futures Research Institute (MFI)															43
Swinburne University of Technology Digital Research Innovation Capability Platform (DRICP)															43
THE UNIVERSITY OF MELBOURNE															44
The University of Melbourne															46
The University of Melbourne - Aerospace															46
The University of Melbourne - Computer Assisted Rehabilitation Environment (CAREN)															47
The University of Melbourne - Cybersecurity															47
The University of Melbourne - Medical Countermeasures															48
The University of Melbourne - Melbourne Information, Decision & Autonomous Systems (MIDAS)															48
The University of Melbourne - Multidisciplinary Materials															49
The University of Melbourne - Maritime Systems															49
The University of Melbourne - Quantum Information															50
VICTORIA UNIVERSITY															52
Victoria University															54
Victoria University - Aerospace Propulsion & Fire Safety															54
Victoria University Institute for Health and Sport (IHES)															55
Victoria University Institute for Sustainable Industries & Liveable Cities (ISILC)															55
DMTC															56
DMTC Limited															58
OCEANIA CYBER SECURITY CENTRE															60
Oceania Cyber Security Centre (OCSC)															61

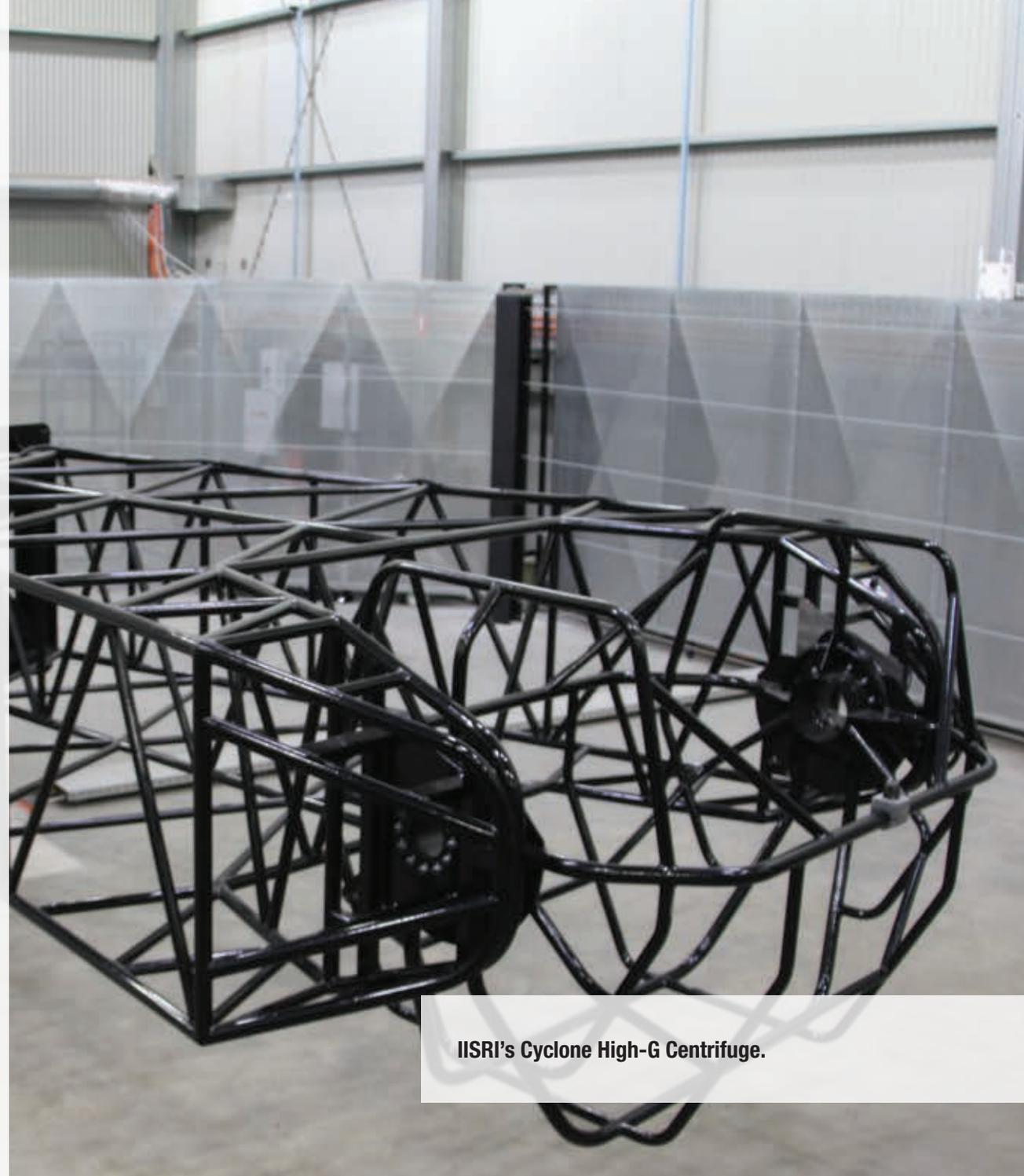




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IISRI's Cyclone High-G Centrifuge.

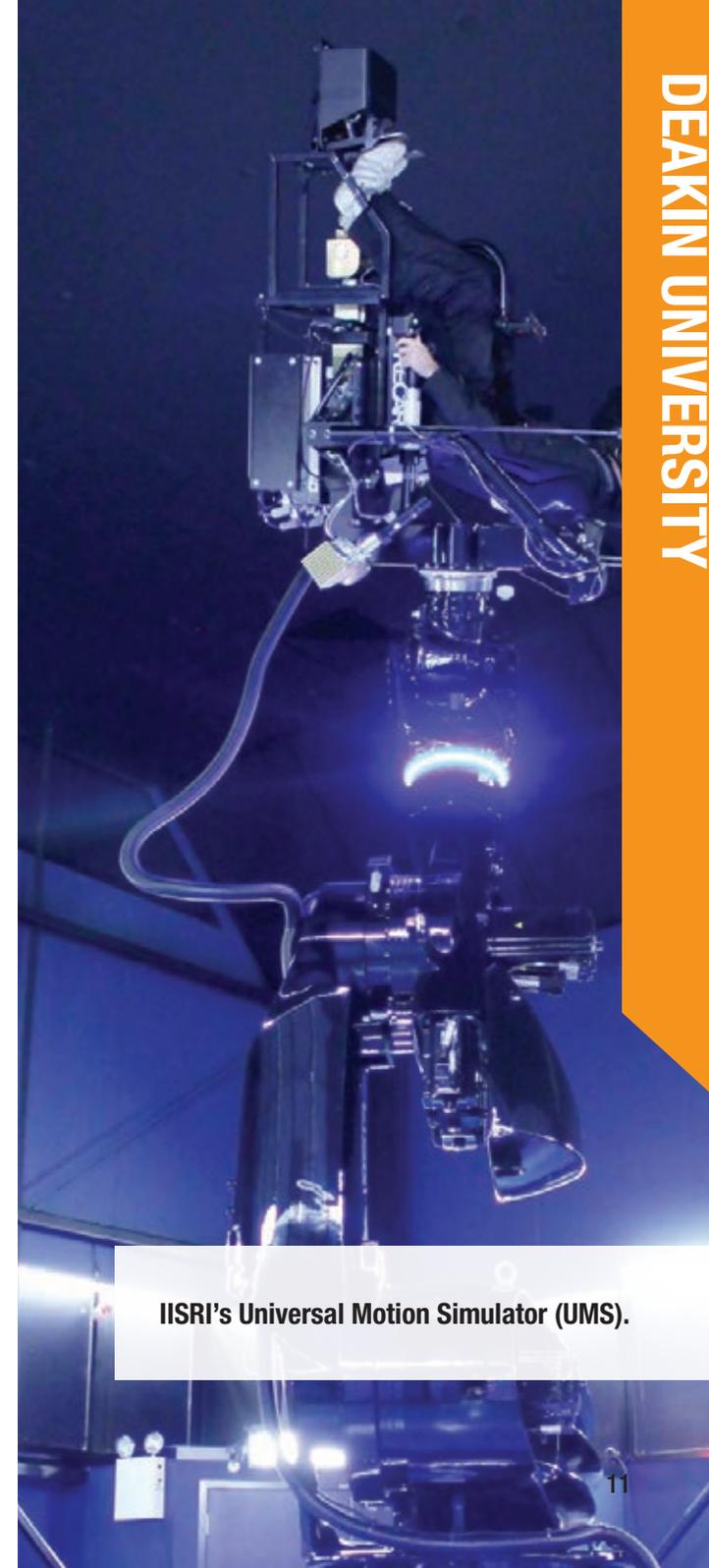
DEAKIN UNIVERSITY AEROSPACE RESEARCH CAPABILITY

Advancing Defence research and innovation for more than 30 years, Deakin University works with the Australian Defence Force and commercial partners to deliver high-TRL R&D solutions and provide cutting edge and smart technologies for the ADF operational advantage.

Deakin's Institute for Intelligent Systems Research and Innovation (IISRI) built the world's first haptically-enabled robot-based motion simulator, the Universal Motion Simulator (UMS). The UMS can simulate different types of land and air vehicles in a virtual environment, without eliciting simulator sickness. IISRI also designed and developed a cyclone low-cost, high-G centrifuge for efficient pilot training in a highly reliable and safe environment. The centrifuge delivers rapid onset rates and sustained G-forces typical of those experienced in modern high-performance fighter aircrafts. It may be utilised for spatial disorientation, situational awareness and upset prevention and recovery training and motion sickness desensitisation.

Hosted by Deakin's Australian Future Fibres Research and Innovation Centre (AFFRIC), Carbon Nexus is the world's first dedicated pilot-scale research plant capable of producing aerospace-grade carbon fibre composites. Carbon Nexus supports the transition to advanced manufacturing in industries as diverse as aerospace, automotive, defence and construction.

The Institute for Frontier Materials (IFM) Battery Technology Research and Innovation Hub (BatTRI-Hub) at Deakin focuses on advanced battery prototyping and commercialisation of energy storage technologies. BatTRI-Hub is creating future "beyond lithium-ion" battery technologies which are light in weight and smart in design to increase portability and function with better energy management systems.



IISRI's Universal Motion Simulator (UMS).

DEAKIN UNIVERSITY

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CAPABILITIES

- Universal motion simulators, motion platforms, flight simulators, land vehicle simulators, tele-operation robotics
- Materials, carbon fibre research and manufacturing, high-strength and lightweight materials, design and optimisation
- Artificial intelligence, machine learning and data analytics
- Battery technologies, advanced battery prototyping, corrosion and protection technologies, power management
- Modelling and simulation, logistics systems, human performance assessment, after action review
- Tele-robotics for counter terrorism, cyber security
- Defence mental and physical health, cognitive load monitoring, psychology, psychiatry, exercise and nutrition
- Virtual reality and augmented reality, mixed reality, haptics

INFRASTRUCTURE

- Institute for Intelligent Systems Research & Innovation (IISRI)
- Institute of Frontier Materials (IFM), BatTRI-Hub, Carbon Nexus
- Institute of Physical Act, Alfred Deakin Institute
- Applied Artificial Intelligence Institute (A2I2), Cyber Security Research and Innovation Centre (CSRI)
- Faculty of Science, Engineering and Built Environment, School of Engineering, School of Information Technology
- Faculty of Health, School of Medicine, School of Exercise and Nutrition Sciences
- School of Psychology, School of Health and Social Development
- School of Nursing and Midwifery, School of Humanities and Social Science

KEY PILLARS		
Advanced Sensors & Processing	•	Modelling, Simulation & Analysis •
Big Data Processing & Visualisation	•	Multi-Disciplinary Material Sciences •
Cyber & IT Security	•	Propulsion & Energy Storage •
Enhanced Human Performance & Protection	•	Quantum Technologies •
Hypersonics & Directed Energy Capabilities	•	Space Systems •
Integrated Intelligence, Surveillance & Reconnaissance	•	Sustainment •
Medical/Pharma Technologies	•	Trusted Autonomous Systems •

DEAKIN UNIVERSITY – INSTITUTE FOR INTELLIGENT SYSTEMS RESEARCH AND INNOVATION (IISRI)

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CAPABILITIES

- Haptically-enabled remote tele-operated robotics for medical and law enforcement applications
- Haptically-enabled medical training simulators
- Universal motion simulator for land, air and sea vehicles
- High-G centrifuge simulator
- VR/AR training simulators
- Advanced artificial and computational intelligence techniques for decision support
- Process modelling and analysis, modelling complex systems
- Human performance assessment, after action review methodologies

INFRASTRUCTURE

- Universal Motion Simulator – world's first haptically-enabled motion simulator
- High-G centrifuge simulator for pilot training
- Motion capture laboratories, motion tracking systems
- Virtual and augmented reality simulators
- Human performance laboratories, eye tracking and EEG systems
- Haptics, autonomous robotics platforms

TECHNOLOGY TRANSFERS

- Haptically-enabled Universal Motion Simulator (UMS)
- High-G centrifuge simulator
- Haptically-enabled needle thoracostomy training simulator
- Haptically-enabled VR/AR firefighting training simulator
- HeroSurg – Haptically-enabled robotic assisted minimally invasive surgical system
- HaptiScan – Haptically-enabled remote tele-operation ultrasound robotic platform
- OzBot and OzTouch – Haptically-enabled tele-operated robotic platforms for counter-IED
- Haptically-enabled VR/AR optometry training simulator

KEY PILLARS		
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Medical/Pharma Technologies	•	Trusted Autonomous Systems •

DEAKIN UNIVERSITY – INSTITUTE FOR FRONTIER MATERIALS (IFM)

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CAPABILITIES

- Fibres, polymers, composites and textiles – new technologies, processes and products
- Alloy design and processing – lightweight materials for increased fuel efficiency
- Biomaterials and biomimicry – inspiration from nature for medical and textile applications
- Corrosion and protection – safeguarding vital infrastructure and industries
- Electromaterials and membranes – creating new electroactive materials
- Materials and process modelling – predicting the way molecules and materials react
- Nano and plasma technology – energy storage, surfaces/ interfaces, novel nanomaterials, liquid plasma
- Carbon fibre pilot scale production including precursor synthesis and composite fabrication

INFRASTRUCTURE

- Advanced Characterisation Facility including electron microscopy, nuclear magnetic resonance and x-ray
- National Facility for Pipeline Coating Assessment – coating assessment and corrosion evaluation, NATA accredited
- Carbon Nexus – carbon fibres, textile pre-forms & composites for developing new technologies, processes & products
- Advanced Plasma Facility – including combined physical vapour/plasma-enhanced chemical vapour deposition
- BatTRI-Hub – advanced battery prototyping, commercialising energy storage technologies, partnership with CSIRO
- Metal Surfaces Facility – wire drawing/crossed cylinders rig, surface/heat treatment testing, GDOES, nanoindenter
- Mechanical Testing Facility – high temperature tension strain-rate, compression, fatigue, bend, shear, Bauschinger
- Light Metals Facility – 300 ton horizontal extrusion press, melting and metal forming, thermo-electric properties

TECHNOLOGY TRANSFERS

- Next generation batteries
- New carbon fibre manufacturing technology and specialised machinery – energy, cost, space and time savings
- HeiQ real silk – short polymer fibre with the key properties of natural silk
- Carbon fibre/composite products including carbon fibre wheels

KEY PILLARS		
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Big Data Processing & Visualisation	Multi-Disciplinary Material Sciences	•
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Hypersonics & Directed Energy Capabilities	• Space Systems	
Integrated Intelligence, Surveillance & Reconnaissance	Sustainment	•
Medical/Pharma Technologies	• Trusted Autonomous Systems	

DEAKIN UNIVERSITY – APPLIED ARTIFICIAL INTELLIGENCE INSTITUTE (A2I2)

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CAPABILITIES

- Simulation – improving complex phenomena prediction and synthetic training through agent and process modelling
- Artificial intelligence – delivering intelligent systems designed to augment human capabilities
- Bayesian optimisation – optimising black-box functions via probabilistic techniques to improve performance
- Data analysis – extracting actionable and valuable insights from large or complex data streams
- Visualisation – enhancing information delivery by employing effective human computer interaction techniques
- Decision support systems – enabling complex decision making by distilling diverse data into holistic information
- Learning support systems – streamlining learning through constructive alignment and activity-based experiences
- Augmented and virtual reality – enriching complex content delivery through immersion and experience design

INFRASTRUCTURE

- Industry Innovation Laboratory
- Advanced Data Analytics and Pattern Recognition Laboratory
- Motion Capture Laboratory
- Augmented and Virtual Reality Laboratory
- Internet of Things Laboratory
- Cyber Security Laboratory
- High-Performance Computing Clusters

TECHNOLOGY TRANSFERS

- TRR – intelligent decision support tool used to assist doctors while treating trauma patients
- iCetana – video surveillance analytics to detect potential security threats in large data sets
- iHosp – big data analytics for hospital management systems
- Ekko – extracting insights from duplex call centre recordings using natural language processing and statistics
- Groundtruth – predicting deterioration of mental state and developing an early-warning system
- EDIE – experiencing dementia via virtual reality in order to educate carers
- Sofihub – digital assisted living and in-home monitoring for the elderly
- TOBY Playpad – learning and early intervention therapy for children living with autism

KEY PILLARS		
Advanced Sensors & Processing	Modelling, Simulation & Analysis	•
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Hypersonics & Directed Energy Capabilities	Space Systems	
Integrated Intelligence, Surveillance & Reconnaissance	• Sustainment	
Medical/Pharma Technologies	Trusted Autonomous Systems	•

DEAKIN UNIVERSITY – CYBER SECURITY RESEARCH AND INNOVATION CENTRE (CSRI)

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CAPABILITIES

- Big data – machine learning and security analytics
- Security by design for critical infrastructure and IoT
- Social media and information security – privacy and surveillance
- Information assurance and privacy preservation
- Cyber security information manipulation and warfare
- Human aspects of cyber security and decision making
- Malware analysis
- Blockchain research and applications

INFRASTRUCTURE

- Malware analysis lab
- Cisco Cyber Range
- Eye tracking technology
- Functional magnetic resonance imaging (fMRI)
- Electroencephalography (EEG)
- Robotics laboratory
- Australian Cyber Protection Centre

TECHNOLOGY TRANSFERS

- Honeypot technologies to detect threat actors
- SME education on cyber security resilience
- Cyber security advice for executives (government and industry)

KEY PILLARS		
Advanced Sensors & Processing		Modelling, Simulation & Analysis
Big Data Processing & Visualisation		Multi-Disciplinary Material Sciences
Cyber & IT Security	•	Propulsion & Energy Storage
Enhanced Human Performance & Protection		Quantum Technologies
Hypersonics & Directed Energy Capabilities		Space Systems
Integrated Intelligence, Surveillance & Reconnaissance		Sustainment
Medical/Pharma Technologies		Trusted Autonomous Systems





IISRI's HAPTISCAN

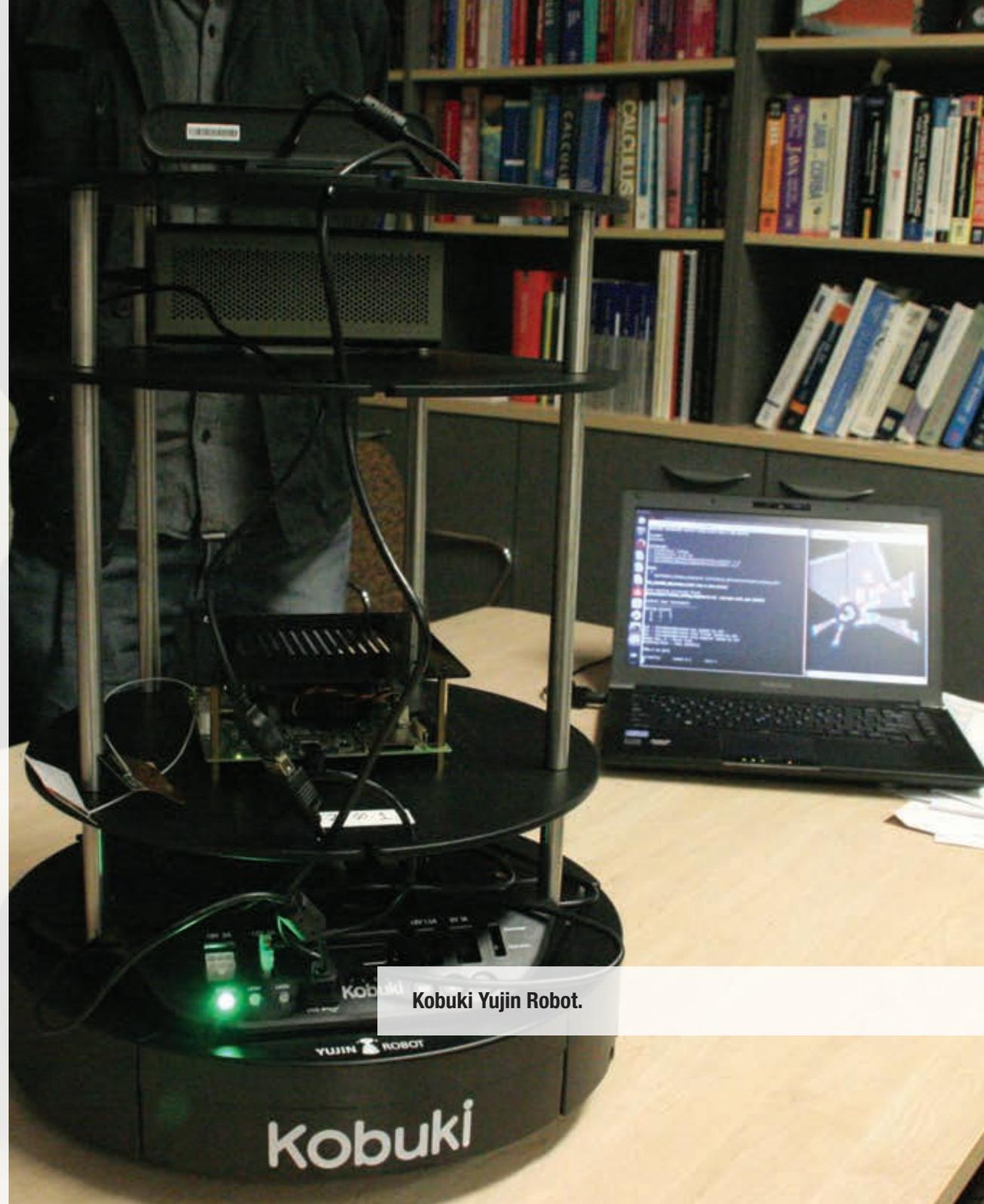
Haptically-enabled remote tele-operation ultrasound robot.



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Kobuki Yujin Robot.

FEDUNI TRANSFORMS KNOWLEDGE TO REALITY

Federation University Australia has unique capabilities that can be applied in defence and aerospace technology development. Sensor technologies, sensor information processing, remote condition monitoring and wireless networks are areas of strength at Federation University Australia. We also undertake work in intelligent image and video analysis to extract knowledge from real time scenes remotely. This real time scene analysis underpins remote operation of drones to undertake complex tasks.

Federation University Australia has extensive real-world experience in remote monitoring of plant and equipment, and associated vibration analysis for detecting incipient faults. Our work in this area supports condition based maintenance and residual life determination, driving down costs and the risk of catastrophic failures.

Physical equipment in the defence and aerospace spheres is required to operate in an increasingly hostile cyber environment. Federation University Australia's Internet Commerce Security Laboratory works at the cutting-edge of vulnerability modelling of physical system (IoT) and cyber-attack analysis to promote confidence in the operational security of interconnected systems.

Federation University Australia is committed to working with industry and government in finding real solutions to developing and future needs.



FEDERATION UNIVERSITY AUSTRALIA

federation.edu.au

Mr Cameron Beyer
 Manager, Commercial Services
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 Email: csu@federation.edu.au

CAPABILITIES

- Development and evaluation of injury prevention measures
- Injury epidemiology – understanding what, who and how
- Improving policy and practice in adult and vocational education and training
- Landscape remediation and rehabilitation
- Human health and biomarker development
- e-mental health interventions including online psychological screening and assessment methods
- Condition monitoring and non-destructive testing techniques

INFRASTRUCTURE

- Aust Centre for Research into Injury in Sport & its Prevention (ACRISP) – member IOC Medical Research Network
- Advanced Industrial Analytics Laboratory – SEM with elemental analysis, chromatography, spectroscopy
- Geotechnical and geomechanical testing facilities
- Centre for Informatics and Applied Optimization (CIAO)
- Internet Commerce Security Lab

KEY PILLARS			
Advanced Sensors & Processing	•	Modelling, Simulation & Analysis	•
Big Data Processing & Visualisation	•	Multi-Disciplinary Material Sciences	•
Cyber & IT Security	•	Propulsion & Energy Storage	
Enhanced Human Performance & Protection	•	Quantum Technologies	
Hypersonics & Directed Energy Capabilities		Space Systems	
Integrated Intelligence, Surveillance & Reconnaissance	•	Sustainment	•
Medical/Pharma Technologies		Trusted Autonomous Systems	•

FEDERATION UNIVERSITY AUSTRALIA – CENTRE FOR INFORMATICS AND APPLIED OPTIMIZATION (CIAO)

federation.edu.au/ciao

Associate Professor Alex Kruger
 Research Director, CIAO
 University Drive, Mt Helen VIC 3350
 Tel: +61 3 5327 9804
 Email: a.kruger@federation.edu.au

CAPABILITIES

- Global, non-smooth and non-convex optimisation including large systems, without the need for large scale computing
- Variational analysis, optimality conditions, duality theory, stability of optimisation and variational problems
- Threat profiling – data mining techniques for identifying cybersecurity threats
- Big data analytics for condition monitoring – real time and remote, information processing
- Development and application of reinforcement learning algorithms for intelligent software agents
- Developing tools and techniques for forensic examination of compromised IT systems
- Identification of and protection against malware
- Multimedia signal processing and machine learning

INFRASTRUCTURE

- Internet Commerce Security Laboratory – advanced analytical techniques for cybercrime and internet security
- Centre for eResearch and Digital Innovation (CERDI) – data interoperability and spatial information portals

KEY PILLARS			
Advanced Sensors & Processing		Modelling, Simulation & Analysis	
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Medical/Pharma Technologies		Trusted Autonomous Systems	•

FEDERATION UNIVERSITY AUSTRALIA – INTERNET COMMERCE SECURITY LAB (ICSL)

federation.edu.au/icsl

Associate Professor Iqbal Gondal
 Director, ICSL
 GEC, University Drive, Mt Helen VIC 3350
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 Email: iqbal.gondal@federation.edu.au

CAPABILITIES

- Advanced analytics for malware attack identification and mitigation for cyber security solutions
- Vulnerability testing for susceptibility to jamming and unauthorised external access
- Developing agents, via learning and BDI frameworks, with unique focus on multi-objective agents and ad-hoc teams
- Cyber-physical systems development and vulnerability modelling
- Intelligence mining from natural language
- Anomaly detection in autonomous systems by analysing vibration signals
- Data mining and AI schemes for pattern recognition for sensor networks information processing
- Robust wireless and sensor networks for uncertain operating conditions

INFRASTRUCTURE

- Secure cyber security lab for the development of cyber security solutions for industry
- Technology park (large, non-built up area for vehicle testing)
- Virtual Reality Lab (simulations)
- Flight simulator

TECHNOLOGY TRANSFERS

- Malware attack detection and prevention at the process injection level for a major bank
- Optimal clustering for phishing attack characterisation for a major bank
- Phisher attack behavior analysis for preventive measures and harm minimisation
- Computer forensics for child exploitation contents analysis for law enforcement agency
- Cyber physical systems vulnerability modeling for optimal mitigation strategies
- Real time sensor information processing for on-farm process condition monitoring for an SME

KEY PILLARS		
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Medical/Pharma Technologies		Trusted Autonomous Systems

FEDERATION UNIVERSITY AUSTRALIA – MECHATRONICS AND RELIABILITY ENGINEERING

federation.edu.au/fost

Professor Steve Wilcox
 Deputy Dean, Engineering and Science
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 Email: steve.wilcox@federation.edu.au

CAPABILITIES

- Engineering system modelling and control
- Sensors, signal processing and AI
- Mechatronics systems
- Condition monitoring, structural health monitoring
- Plant performance monitoring and analysis
- Cyber physical systems

INFRASTRUCTURE

- Robotic systems for training and prototyping – Kawasaki RS006L, BAXTER Research Robot
- OMRON Vision Sensors and Machine Vision Systems – industrial scale
- OMRON Machine Automation Controllers – industry compatible programmable controllers
- National Instrument Data Acquisition Systems – including PXI and myDAQ
- QuantumX system and Dynamic Optical Interrogator
- Industry standard data acquisition software – LabVIEW, MultiSim, Abacus, Sysmac Studio, Inventor

TECHNOLOGY TRANSFERS

- Pneumatically driven master-slave fingers movement control using Hall-effect sensory system
- Structural health monitoring of bridges using fibre Bragg sensors
- Furnace monitoring and modelling for increased efficiency
- Digital imaging and data processing for real-time object size identification and sorting

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Medical/Pharma Technologies		Trusted Autonomous Systems



LA TROBE
UNIVERSITY

latrobe.edu.au

PRIMARY CONTACT

Professor Rachel Huxley
Associate Pro Vice-Chancellor (Research)
defence@latrobe.edu.au

Time-of-flight secondary ion mass spectrometer.

A UNIVERSE OF POSSIBILITIES AT LA TROBE

La Trobe University is making giant leaps with its research and development work in defence and aerospace. In a recent collaboration with the German Aerospace Centre, La Trobe has seen their DLR Earth Sensing Imaging Spectrometer (DESI) high-resolution camera launched into space on one of Elon Musk's SpaceX rockets.

Attached to the International Space Station, the camera will monitor bushfires, floods, ash clouds, storms and rainfall across the globe. The DESIS camera is a huge win for La Trobe but it's simply the most high-profile in a range of exciting projects happening at the University.

La Trobe's work in advanced sensors, signal processing and big data have applications in everything from driverless transport to healthcare. Imagine an automated fleet of trucks moving produce from farm to market at the moment of harvest. The farmer, who is diabetic, has a sensor in her arm that updates her health data in real time. This lets her doctor know important information without the need for invasive techniques.

Two hundred kilometres away, a fleet of drones developed with La Trobe fight a bushfire. Protected by a fireproof coating, the drones work as a team, using modelling, simulation and analysis techniques to predict where the blaze will go next. On the ground, an experienced firefighter helps them stay on task. Up above, DESIS provides essential intelligence to the operation.



Scanning Auger Nanoprobe.

LA TROBE UNIVERSITY

latrobe.edu.au

Ms Alison Angleton
Deputy Director, Industry Engagement
La Trobe University, Bundoora VIC 3083
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CAPABILITIES

- Advanced electronic systems for use in extreme environments
- Big data – data mining, memory storage, information retrieval, image processing, pattern recognition
- Nanocharacterisation – surface science, analysis, imaging and synchrotron domains
- Quantum materials for electronics, spintronics and biosensing
- On-board control systems for processing satellite imaging data
- Nano-scale x-ray imaging and spectroscopy
- Accountability, performance management and organisational processes in the public sector
- Emotionally engaging social technologies for 'person-centred' care and well-being

INFRASTRUCTURE

- DLR Earth Sensing Imaging Spectrometer (DESI) on the International Space Station
- Data to Decisions CRC
- Surface analysis facility – ultrahigh vacuum instrumentation, synchrotron end stations, spectrometry, diffraction
- Atom-scale Research Laboratory
- Plasma and electro deposition fabrication facilities
- Research Centre for Computers, Communication and Social Innovation
- Centre for Public Sector Governance, Accountability and Performance
- Institute for Human Security and Social Change

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LA TROBE UNIVERSITY – AGRIBIO RESEARCH CENTRE

latrobe.edu.au/agribio

Professor Jim Whelan
Co-Director, AgriBio
La Trobe University, Bundoora VIC 3083
Tel: +61 3 9479 1111
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CAPABILITIES

- Nutrition, obesity and related disorders
- Parasite control
- Gene discovery and functional genomics
- Molecular interactions at the plant-fungal interface
- Genetic and molecular factors affecting cancer metastasis
- Biosensors
- Forensic science applications
- Synthetic biology

INFRASTRUCTURE

- DNA sequencing and genotyping for plants, livestock and microbes
- Specialised software for bioinformatics and complex statistical analysis
- Nuclear magnetic resonance spectrometer and multiple mass spectrometers
- Controlled environment rooms for plant and pest research

TECHNOLOGY TRANSFERS

- Molecular diagnostics, biological control and other management strategies for weeds, plant, animal pests and diseases
- Physiology and genetics related to plant and animal bioactives and health
- Molecular breeding for disease resistance, drought tolerance, bioenergy and health
- Development of sustainable systems for animal and plant production

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Medical/Pharma Technologies	•	Trusted Autonomous Systems	

LA TROBE UNIVERSITY – CENTRE FOR TECHNOLOGY INFUSION (CTI)

latrobe.edu.au/technology-infusion

Professor Aniruddha Desai
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CAPABILITIES

- Micro-nano electronics design, modelling and simulation
- System-on-chip design, modelling and simulation
- Wireless sensor networks
- Ultra-low power embedded systems
- Signal, low-power and integrated system-on-chip design
- RF 6 GHz industrial chip design
- Sensory systems data analysis
- RF and digital multi-layer PCB circuit and antenna design, quick prototyping and characterisation

INFRASTRUCTURE

- Micro/nanotechnology Realisation Facility (MRF)
- Synopsys, Coventorware, Altium and Mentor Graphics design suites
- Altera, Actel and Xilinx development platforms
- High Frequency RF lab – 18 GHz osc, spectrum analyser, VNA, power analyser, battery simulator
- National Networked TeleTest Facility (NNTF) – engineering, pre-production test and characterisation services
- Melbourne Centre for Nanofabrication
- ARM micro-controller IPs
- Synopsys various memory IPs

TECHNOLOGY TRANSFERS

- Intelligent Transport System – wireless technology improving safety at level crossings
- Smart Energy Management System – energy monitoring and load management
- Smart-r-tag – smart asset tag for monitoring condition-sensitive items as they move through the supply chain

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LA TROBE UNIVERSITY – ENGINEERING & MATHEMATICAL SCIENCES

latrobe.edu.au/school-engineering-and-mathematical-sciences

Associate Professor Ing Kong
Advanced Materials & Metallurgy
La Trobe University, Bundoora VIC 3083
Tel: +61 3 5444 7339
Email: i.kong@latrobe.edu.au

CAPABILITIES

- High performance digital electronics design including FPGA and embedded systems
- Over the horizon radar
- Space, satellites and demanding environments
- Remote sensing using radar, satellite, fixed wing, UAV, and ground-based systems
- Advanced image/signal processing and compression
- Design, modeling and prototyping – mechanical, electronics, robotics and automation
- Advanced metals for space, aerospace, defence and biomedical products
- Specialised simulation, design and testing – maritime, RF, cyber-physical

INFRASTRUCTURE

- Over the horizon radar (Tiger Radar)
- Specialists in conducting research in industry
- Access to aerospace and defence foundry (key partnership)
- Major engineering infrastructure and activities in regional / central Victoria (Bendigo Campus)
- World leading FPGA development facility
- Centre for Technology Infusion (autonomous vehicles and systems)
- Micro and nanotechnology

TECHNOLOGY TRANSFERS

- Tiger Radar: Buckland Park (South Australia), British Antarctic Survey, South African National Space Agency (SANSA)
- Autonomous vehicle technology
- Precision FPGA, hardware and software for space platforms.
- Cochlear signal processing

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LA TROBE UNIVERSITY – SPORT & EXERCISE MEDICINE RESEARCH CENTRE (LASEM)

latrobe.edu.au/sport-and-exercise-medicine

Professor Kay Crossley
Director, LASEM
La Trobe University, Bundoora VIC 3083
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CAPABILITIES

- Prevention and management of sports and exercise-related injury
- Development and evaluation of exercise and rehabilitation in health and disease
- Large grouping of clinical disciplines focused on the management and prevention of injury
- Close working collaborations with elite sports and industry

INFRASTRUCTURE

- State-of-the-art Gait Laboratory
- Vicon 3D motion analysis system and GAITRite walkway
- 3D foot scanner and plantar pressure analysis equipment – Matscan, Pedar and Emed
- Neurocom Balance Master and Humac Dynamometer
- Ultrasound tissue characterisation (UTC) – 3D tendon imaging and quantification of tendon structure
- Neuroplasticity Research Laboratory (NRL) – non-invasive methods of measuring neuroplasticity

TECHNOLOGY TRANSFERS

- Reduced injury incidence by 30% in Australian navy recruits with prefabricated foot orthoses
- Developed commercial footwear for the prevention of falls in older adults
- Developed and tested an effective falls prevention program for older adults
- Developed and tested effective treatments for common foot, knee, hip and shoulder injuries

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LA TROBE UNIVERSITY – LA TROBE INSTITUTE FOR MOLECULAR SCIENCE (LIMS)

latrobe.edu.au/lims

Professor Andrew Hill
Director, LIMS
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CAPABILITIES

- Neurobiology – biology and diseases associated with the nervous system
- Molecular sensing – identifying and quantifying chemical and biochemical species in the environment and human body
- Infection and immunity – molecules used by infections and the immune response associated with this
- Molecular design – using molecules to solve real world problems across a broad range of disciplines
- Molecular imaging – using a broad range of methods to characterise molecular structure and function
- Cancer – mechanisms of cancer initiation and progression

INFRASTRUCTURE

- Comprehensive Proteomics Platform – suite of synergistic capabilities for the characterisation of proteins
- Centre for Materials & Surface Science – Australia's most comprehensive surface science and surface analysis
- LIMS Bioimaging facility – range of high performance confocal and conventional widefield microscopes
- Flow cytometry – analysis or physical collection of fluorescently labelled cells
- LIMS Histology Facility – suite of precision instruments for high quality specimen preparation and sectioning
- Comprehensive range of different types of qualitative and quantitative mass spectrometry

TECHNOLOGY TRANSFERS

- Treating sepsis – identified mechanism of immune cell death & developed a treatment using a bile acid derivative
- Testing drug compounds that showed a reversal of Parkinson's Disease symptoms
- Discovery of a novel mechanism that forces cancer cells to self-destruct
- Identification of how African Swine Fever hijacks cells to establish infection
- Developed an ultra-thin film that enables the coding of light at the nanoscale
- Developed new imaging techniques to characterise the interaction of protein microcrystals and x-rays
- Developed a surface that improves antibody orientation and enhances the sensitivity of disease detection in blood

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Driverless autonomous bus.



MONASH
University

monash.edu.au

PRIMARY CONTACT

Mr Ken Sloan

Deputy Vice-Chancellor (Enterprise)

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3D PRINTED JET ENGINE

World-first 3D-printed jet-engine created by Monash researchers.

MONASH UNIVERSITY AEROSPACE ENGINEERING

Monash University undertakes world-leading research relevant to the aerospace sector. Our research in turbulent flows, in particular turbulent boundary layer flow, includes internationally recognised expertise in laser diagnostics applied to fluid mechanics, and in direct numerical simulation of turbulent flows. Monash researchers have developed a range of measurement techniques for the study of supersonic jets to provide new physical insight into various aeroacoustic mechanisms, and have commissioned a new laboratory for the study of supersonic flow.

The University conducts world-leading research in additive manufacturing and 3D printing that brings significant opportunities to the aerospace industry where bespoke parts with complex geometry are common. We are leaders in our field, with accomplishments including the world's first 3D-printed aerospike nozzle, a world-leading 3D-printed gas turbine engine and hybrid rocket combustion chamber components constructed from carbon-fibre. In addition to our specialist capability in metals and alloys – ranked seventh in the ARWU 2018 World subject ranking – our expertise in nanomaterials, polymers, composites, corrosion, advanced materials characterisation and materials modelling, offer relevant application to the aerospace sector.

We hold specialist capability in autonomous systems, working with complex aerospace systems. Of note is our electronics and telecommunications research, including high-speed digital electronics, IoT Networks, Uplink/Downlink using radio frequency technologies. The Monash CyberSecurity Lab has expertise in protecting communication for various kinds of disruption. The university offers the Bachelor of Aerospace Engineering (Honours) as well as courses in Aviation Medicine.



SENSILAB, MONASH UNIVERSITY

SensiLab is a technology-driven, design-focused research lab based at Monash University in Melbourne, Australia.

CAPABILITIES

- Advanced and additive manufacturing
- Energy production, storage and transport
- Mechanical and aerospace engineering
- Wireless telecommunications
- Critical care, trauma and perioperative medicine
- Neurosciences and mental health
- Drug delivery, disposition and dynamics
- Optimisation and constraint modelling

INFRASTRUCTURE

- Ramaciotti Centre for Cryo-Electron Microscopy incl Titan Krios, SEM, TEM, immuno EM, light, electron, cryo
- Monash Energy Materials and Systems Institute (MEMSI)
- Monash Instrumentation Facility
- Multi-modal Australian ScienceS Imaging and Visualisation Environment (MASSIVE)
- Melbourne Centre for Nanofabrication (MCN)
- RoboCore including Tecan Freedom Evo and Fluent workstations
- Monash Wind Tunnel Facility including low speed automotive aerodynamic testing
- Monash X-Ray Platform: structural characterisation of engineered and geological materials

TECHNOLOGY TRANSFERS

- Interactive water flow optimisation tool for urban water utilities
- SupraG Energy: next generation capacitors for energy storage
- Ionic Industries: graphene-based technologies
- Oxytocin inhaler removing the need for refrigeration
- Layout optimisation and interactive visualisation software for plant and factory design
- Acrux: spray-on drug delivery technology
- 2D Water: new membranes for desalination and water purification
- 4Dx: four-dimensional x-ray imaging technology

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Medical/Pharma Technologies	•	Trusted Autonomous Systems	•

CAPABILITIES

- Advanced fluid dynamics including water channel studies, particle imaging velocimetry
- Aero-acoustics, including ultra high speed schlieren imaging
- Computational fluid dynamics, including large eddy simulation and direct numerical simulation
- Alloy and composite design and manufacture, including additive manufacture, material protection and remediation
- Degrees and courses, including Bachelor of Aerospace Engineering (Honours) and programs in Aviation Medicine

INFRASTRUCTURE

- Monash Wind Tunnel Platform (ISO 9001 certified)
- Monash Additive Manufacturing (ISO 9001 certified)
- Laboratory for Turbulence Research in Aerospace and Combustion
- Monash Centre for Electron Microscopy (ISO 9001 certified)

TECHNOLOGY TRANSFERS

- Material repair and degradation mitigation strategies for aerospace platforms
- Rapid component design and prototyping
- Aerodynamic computational modelling

KEY PILLARS			
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MONASH UNIVERSITY – CENTRE FOR ADDITIVE MANUFACTURING (MCAM)

platforms.monash.edu/mcam

Professor Xinhua Wu
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CAPABILITIES

- Additive manufacturing at full scale and near-full scale – powder bed and blown powder machines
- Alloy design for additive manufacture
- Process design for additive manufacture
- Design / re-design of complex geometry parts
- Post additive manufacturing process development
- NDE process development for additive manufacturing
- Process and quality control
- Rapid prototyping

INFRASTRUCTURE

- ISO9001 certified facility including selective laser melting machines
- Concept Laser XLine 2000R -1Kw fiber laser, Al, Ti, Ni processing, heated build platform, Ar processing atmosphere
- EOS M280 SLM – 400W fiber laser, Al, Ti, Ni processing, Ar or N processing atmosphere
- Avure QIH-9 Hot Isostatic Press – up to 2000°C, up to 3000 Bar pressure, graphite and Mb furnaces, Ar processing
- Trumpf TruLaser Cell 7040 direct laser deposition – 5 axis, twin powder, full CNC

TECHNOLOGY TRANSFERS

- AMAERO Engineering – additive manufacturing of aerospace components
- Rapid component design and prototyping
- Material repair strategies for defence platforms
- Energy storage devices for spin off companies

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Medical/Pharma Technologies	Trusted Autonomous Systems	

MONASH UNIVERSITY – MAINTENANCE TECHNOLOGY INSTITUTE (MTI)

monash.edu/engineering/mti

Mr Gerard Chitty
Managing Director, MTI
Monash University, Clayton, VIC 3800
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CAPABILITIES

- Structural integrity, risk and reliability assessment of mobile and fixed plant
- FE modelling and analysis
- Catastrophic failure investigations and root cause analysis
- Instrumentation and measurement
- Performance improvement
- Decision support
- Lubrication maintenance improvement and wear debris analysis

INFRASTRUCTURE

- Remote Monitoring Centre – remote data acquisition and condition monitoring
- Data acquisition and condition monitoring systems capable of monitoring performance parameters
- Embedded algorithms capable of analysing data in real time

TECHNOLOGY TRANSFERS

- Real-time condition monitoring systems for mine, oil and gas, and port infrastructure
- Evidence-based operator training for optimum performance
- Failure investigations and remediation
- Equipment performance dashboard

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MONASH UNIVERSITY – BIOMEDICAL AND PHARMACEUTICAL SCIENCES

monash.edu/medicine, monash.edu/pharm

Dr Svetozar (Steven) Kovacevic
Director, Research and Research Degrees, MNHS
Monash University, Clayton VIC 3800
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CAPABILITIES

- Sleep and fatigue – effect on mood, memory and cognition, and role in disorders such as depression and PTSD
- Traumatic brain injury – studying neural genetics and chemistry to develop cognitive and behavioural treatments
- Accident research – prevention, management and rehabilitation of injury, transport safety technologies
- Emergency and trauma medicine – paramedic training, resuscitation, disaster preparedness and management
- Medical devices – prosthetics, biosensors, bionic vision, mind-machine interface, anti-microbial materials
- Infectious diseases – therapies targeting 'superbugs', vector-borne infections, vaccines, immune dysfunction
- Pharmaceuticals – drug discovery and medicinal chemistry, candidate optimisation, novel delivery mechanisms
- Regenerative medicine – heart and muscle development, immunity, neural regeneration, stem cell regeneration

INFRASTRUCTURE

- Advanced Technology Research Platforms (ISO accredited) – imaging, antibodies, animals incl non-human primates
- Australian Regenerative Medicine Institute
- Monash Biomedicine Discovery Institute
- Monash Institute of Cognitive and Clinical Neurosciences/ BrainPark
- Monash Institute of Medical Engineering
- Monash Institute of Pharmaceutical Sciences
- Monash Partners Academic Health Science Centre
- Monash University Accident Research Centre

TECHNOLOGY TRANSFERS

- Relenza – anti-influenza drug developed by Biota and Monash, marketed by Glaxo Smith Kline
- Cancer therapeutics – drugs for both cancer and non-cancer blood disorders, licensed to Merck
- Bionic eye with Monash Vision Group in partnership with Minifab and Grey Innovation
- Attention software – world first training program, TALI, aimed at increasing attention and concentration
- Hazelwood – studying exposure to smoke from coal mine fire on cardiovascular and pulmonary health
- Rheumatoid arthritis – research in early detection and prevention, in partnership with Johnson & Johnson/ Janssen
- Ionic liquid technology – drug delivery technology acquired by Capsugel
- Heads-up smartglasses for trauma resuscitation and reception, trauma reception and resuscitation software

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MONASH UNIVERSITY – ENGINEERING

monash.edu/engineering

Professor Chris Davies
Head, Mechanical and Aerospace Engineering
Monash University, Clayton VIC 3800
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Email: Chris.Davies@monash.edu.au

CAPABILITIES

- Advanced fluid dynamics – hydrodynamics, turbulence, experimental and CFD capabilities
- Engineering alloy design and characterisation – light alloys (Al, Ti, Mg), steels, composites
- Intelligent robotics – vision systems, haptics, human/machine interaction, decision augmentation, swarm robotics
- Energy storage – low emission, low energy technologies
- Sensor networks, wireless networks, photonics
- Biomedical engineering – implants, biomaterials, imaging
- Micro and nano scale mechanical devices
- Materials for personnel and vehicle protection

INFRASTRUCTURE

- Laboratory for Turbulence Research in Aerospace and Combustion – PIV, including holographic PIV
- Monash Wind Tunnel – ISO9001 certified, vehicle aerodynamics at full and reduced scale
- New Horizons Research Centre – including materials characterisation labs, polymer and metal additive manufacturing
- Monash Centre for Electron Microscopy – SEM and TEM instrumentation
- Monash X-Ray Platform – x-ray characterisation of engineering materials
- Monash Energy Materials and Systems Institute (MEMSI) – new energy technologies
- Monash Institute of Medical Engineering – translational medtech

TECHNOLOGY TRANSFERS

- Vehicle aerodynamic testing and optimisation
- Hydrodynamic modelling for optimisation of defence platforms
- Material repair strategies for defence platforms
- Woodside Innovation Centre
- Rapid component design and prototyping
- Energy storage devices for spin-off companies

KEY PILLARS			
Advanced Sensors & Processing	•	Modelling, Simulation & Analysis	•
Big Data Processing & Visualisation		Multi-Disciplinary Material Sciences	•
Cyber & IT Security		Propulsion & Energy Storage	•
Enhanced Human Performance & Protection	•	Quantum Technologies	•
Hypersonics & Directed Energy Capabilities	•	Space Systems	•
Integrated Intelligence, Surveillance & Reconnaissance	•	Sustainment	
Medical/Pharma Technologies	•	Trusted Autonomous Systems	•

CAPABILITIES

- Cybersecurity – cryptographic algorithms, trusted computing, block-chain, information privacy to users
- Modelling, optimisation, immersive analytics/visualisation, augmented/virtual reality supporting decision making
- Machine learning for monitoring and assistance systems, behavioural modelling, information retrieval
- Data capture, analysis and visualisation of individual data from mobile device and sensors
- Technologies for robust authentication and identification in uncontrolled environments with pervasive devices
- Artificial intelligence – Bayesian techniques, knowledge acquisition and processing, natural language
- Design and build custom wearable and internet of things (IoT) technologies with mobile apps and cloud technology
- Develop advanced AR/VR technologies to support (collaborative) data analysis and decision making

INFRASTRUCTURE

- Monash Immersive Visualisation Platform – including hybrid reality environment
- Monash eResearch Centre
- Monash Centre for Data Science
- Monash Decision Support Systems Laboratory
- Monash Swarm Robotics Laboratory

TECHNOLOGY TRANSFERS

- Asset monitoring hardware and software
- Constraint and optimisation modelling programming languages
- Optimisation software – workforce planning, production schedules, freight, timetabling operations

KEY PILLARS

Advanced Sensors & Processing	Modelling, Simulation & Analysis	•
Big Data Processing & Visualisation	• Multi-Disciplinary Material Sciences	
Cyber & IT Security	• Propulsion & Energy Storage	
Enhanced Human Performance & Protection	• Quantum Technologies	
Hypersonics & Directed Energy Capabilities	Space Systems	
Integrated Intelligence, Surveillance & Reconnaissance	• Sustainment	
Medical/Pharma Technologies	• Trusted Autonomous Systems	•



**Monash Mechanical and Aerospace
Engineering Laboratory for Turbulence
Research in Aerospace and Combustion.**



rmit.edu.au

PRIMARY CONTACT

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A satellite in orbit. Source NASA.

RMIT UNIVERSITY, WHERE YOUR DEFENCE IS OUR STRENGTH

RMIT University has a longstanding and trusted relationship with the Defence industry. Strong national and international partnerships with the Department of Defence, DST Group, the Defence forces, Defence Primes and SMEs have enabled the University to deliver technology, education and workforce skills development.

The Sir Lawrence Wackett Centre is RMIT's signature Defence centre that vertically integrates core capability across the entire university. Through the Sir Lawrence Wackett Centre, RMIT supports industry transformation and innovation by delivering high quality technological, policy and business solutions, providing expert advice, and supporting capability development in critical areas of education and workforce training.

With more than 60 years' experience in the aerospace and aviation sectors, RMIT is a national leader in tailored engineering solutions for these and related industries. Aerospace Engineering at RMIT was rated 5 out of 5 in the 2015 Excellence in Research for Australia (ERA) assessment and that same assessment rated RMIT as number one in Australia in this field.

RMIT's research capabilities are supported by world-class facilities and research centres such as the Advanced Manufacturing Precinct and the S.P.A.C.E. Centre specialising in Geospatial Sciences.

SPACE TECHNOLOGIES

RMIT's Robotic Optical Observatory (ROO) telescope is designed to track and photograph satellites and space debris orbiting Earth, and thereby conduct research into how to better track objects in space and increase orbit predictions so that collisions can be avoided.

CAPABILITIES

- Australia's largest dual-sector university, offering vocational, technical, degree and post graduate studies
- Research spans all Defence sectors, including maritime, aerospace, land, digital and human domains
- A leading university in the Space Environment Research Centre (SERC) Research Program
- A founding member of the Defence Cooperative Research Centre on Trusted Autonomous Systems
- Outstanding capability in electronic and telecommunications engineering, advanced sensors and power systems
- Specialised focus on human performance and protection including high strength fabrics for combat clothing
- Long history of developing and commercialising vaccine technologies and wound management innovation
- Large scale provision of Defence work-force skills including the Diploma of Aviation Maintenance Management

INFRASTRUCTURE

- RMIT's Sir Lawrence Wackett Centre houses a flight dynamics facility including wind tunnels and simulators
- RMIT's Advanced Manufacturing Precinct (AMP) has metal and polymer additive manufacturing systems and 3D Printing
- The MicroNano Research Facility has extensive equipment for the design and fabrication of micro-nano scale devices
- The Centre for Materials, Innovation & Future Fashion (CMIFF) manufactures high strength & anti-ballistic fabrics
- The Centre for Advanced Electronics and Sensors (CADES) develops new sensors, electronics and functional materials
- The Food Research and Innovation Centre has food analysis and product development laboratories and pilot plants
- The Microscopy and Microanalysis Facility has a broad range of electron microscopes and related imaging techniques
- Satellite Positioning Atmosphere, Climate and Environment Research Centre for space research

TECHNOLOGY TRANSFERS

- High strength protective woven fabrics that mitigate lower limb injuries caused by explosive devices
- High speed photonic modulators enabling radar countermeasures to be distributed over Defence platforms
- Novel portable and rechargeable power supply based on a reversible hydrogen fuel cell to support forward operations
- Sensors that enable UAVs to fly in high levels of turbulence to improve ISTAR missions
- Capsule sized high technology gas sensors that can transmit information wirelessly

KEY PILLARS			
Advanced Sensors & Processing	•	Modelling, Simulation & Analysis	•
Big Data Processing & Visualisation	•	Multi-Disciplinary Material Sciences	•
Cyber & IT Security	•	Propulsion & Energy Storage	•
Enhanced Human Performance & Protection	•	Quantum Technologies	•
Hypersonics & Directed Energy Capabilities	•	Space Systems	•
Integrated Intelligence, Surveillance & Reconnaissance	•	Sustainment	•
Medical/Pharma Technologies	•	Trusted Autonomous Systems	•

CAPABILITIES

- Multifunctional materials and advanced manufacturing including composites technologies
- Space situational awareness, satellite positioning and navigation and space technology
- Trusted autonomy and automation including artificial intelligence and human-machine interfaces
- Human performance, protection and human-machine interaction
- Transport, infrastructure, power and energy including logistics
- Trans-disciplinary design and virtual prototyping including life cycle analysis
- Surveillance, sensors, information and communication technologies including quantum technologies & data analytics
- Defence workforce education, training and development including pilot training and flight simulation

INFRASTRUCTURE

- Sir Lawrence Wackett Centre – houses a flight dynamics facility including wind tunnels and simulators
- Satellite Positioning Atmosphere, Climate and Environment Research Centre for space research
- MicroNano Research Facility has extensive equipment for the design and fabrication of micro-nano scale devices
- The Centre for Materials, Innovation & Future Fashion (CMIFF) manufactures high strength & anti-ballistic fabrics
- Advanced Manufacturing Precinct has metal and polymer additive manufacturing systems and 3D printing
- The Centre for Advanced Electronics & Sensors (CADES) develops new sensors, electronics and functional materials
- RMIT Flight Training School located at Point Cook
- Air Traffic Management Research Laboratory and Aircraft/Autonomous Systems Laboratory

TECHNOLOGY TRANSFERS

- World's first Autonomously Soaring Eagle relying entirely on updrafts to stay airborne
- The Black Kite – a water resistant, water recoverable, maritime Robotic Process Automation UAV
- Air traffic management systems
- Models for the orbit determination of space objects – real-time precise orbit determination
- Global Navigation Satellite Systems (GNSS) – high accuracy real-time positioning
- Sensors that enable UAVs to fly in turbulent environments to improve ISTAR missions
- Collision avoidance radar for unmanned aerial vehicles and portable radar for Defence
- Additive manufacturing and repair for Defence aircraft and hybrid composite materials and structures

KEY PILLARS			
Advanced Sensors & Processing	•	Modelling, Simulation & Analysis	•
Big Data Processing & Visualisation	•	Multi-Disciplinary Material Sciences	•
Cyber & IT Security	•	Propulsion & Energy Storage	•
Enhanced Human Performance & Protection	•	Quantum Technologies	•
Hypersonics & Directed Energy Capabilities	•	Space Systems	•
Integrated Intelligence, Surveillance & Reconnaissance	•	Sustainment	•
Medical/Pharma Technologies	•	Trusted Autonomous Systems	•

CAPABILITIES

- Autonomous navigation and collision avoidance
- Design and development of robotic systems and unmanned/autonomous systems
- Flight control and aerodynamics of autonomous vehicles, including micro air vehicles
- Modelling and simulation of complex and autonomous systems
- Operation, certification and training for UAV operators
- Optimisation and operations management for autonomous systems

INFRASTRUCTURE

- Aircraft Systems/Autonomous Systems Laboratory
- Centre for Advanced Electronics and Sensors
- Centre for People, Organisation and Work
- Human Factors Engineering Laboratory and Human Machine Interaction Laboratory
- Unmanned Aircraft Systems Laboratory
- Virtual Experiences Laboratory

TECHNOLOGY TRANSFERS

- Collision avoidance radar for unmanned air vehicles
- Autonomous aerial systems for applications in complex urban environments

KEY PILLARS		
Advanced Sensors & Processing	Modelling, Simulation & Analysis	•
Big Data Processing & Visualisation	• Multi-Disciplinary Material Sciences	
Cyber & IT Security	Propulsion & Energy Storage	
Enhanced Human Performance & Protection	Quantum Technologies	
Hypersonics & Directed Energy Capabilities	Space Systems	
Integrated Intelligence, Surveillance & Reconnaissance	Sustainment	•
Medical/Pharma Technologies	Trusted Autonomous Systems	•

CAPABILITIES

- Advanced bio-sensors for health monitoring
- Human protection, performance and comfort, including high strength textiles and helmet design & evaluation.
- Human-computer interaction, virtual reality
- Medical counter-measures, preventive immunology, vaccine development
- Physical performance (strength, endurance, fatigue) and sports biomechanics
- Vision, auditory and cognitive functions
- Physical performance (strength, endurance, fatigue)
- Waste treatment and water harvesting, oxygen harvesting

INFRASTRUCTURE

- Bio-Technology Laboratories
- Centre for Communication, Politics and Culture
- Centre for Game Design Research
- Centre for Materials Innovation and Future Fashion
- Centre for People, Organisation and Work
- Food Research Innovation Centre
- Human Factors Engineering Laboratory
- Human Machine Interaction Laboratory and Virtual Experiences Laboratory

TECHNOLOGY TRANSFERS

- Soft armour
- High strength fabrics for combat clothing
- Personal protective equipment
- Molecular weight armour
- Vaccines against necrotic enteritis
- Human gas monitoring capsule

KEY PILLARS		
Advanced Sensors & Processing	Modelling, Simulation & Analysis	
Big Data Processing & Visualisation	Multi-Disciplinary Material Sciences	
Cyber & IT Security	Propulsion & Energy Storage	
Enhanced Human Performance & Protection	• Quantum Technologies	
Hypersonics & Directed Energy Capabilities	Space Systems	
Integrated Intelligence, Surveillance & Reconnaissance	Sustainment	
Medical/Pharma Technologies	• Trusted Autonomous Systems	•

CAPABILITIES

- Air traffic management
- Cryptology, cyber and quantum technologies
- Data analytics
- Geospatial information and situation awareness
- Information, data and communication security
- Machine learning
- Network design
- Photonics and wireless communication

INFRASTRUCTURE

- Air Traffic Management Research Laboratory
- Autonomous Systems Laboratory
- Centre for Ultrahigh Bandwidth Devices for Optical Systems (CUDOS)
- Communication Technologies Research Centre
- Human Factors Engineering Laboratory
- Information Security and Network Science Group
- Theoretical Chemical and Quantum Physics Group

TECHNOLOGY TRANSFERS

- Air traffic management systems
- Data mining and analytics
- Information collection and fusion
- User authentication, risk evaluation and threat detection
- Credit card fraud detection

KEY PILLARS		
Advanced Sensors & Processing	Modelling, Simulation & Analysis	•
Big Data Processing & Visualisation	• Multi-Disciplinary Material Sciences	
Cyber & IT Security	• Propulsion & Energy Storage	
Enhanced Human Performance & Protection	Quantum Technologies	•
Hypersonics & Directed Energy Capabilities	Space Systems	•
Integrated Intelligence, Surveillance & Reconnaissance	• Sustainment	
Medical/Pharma Technologies	Trusted Autonomous Systems	

CAPABILITIES

- Additive manufacture (metals and polymer structures)
- Composite materials and light alloys – design, testing and manufacture
- Fabrics and textiles – design, testing and manufacture
- Impact damage mechanics and materials repair technology
- Industry 4.0 (internet enabled manufacturing)
- Integrated circuits and microsystems (ceramic, metal and functional materials) and embedded sensors
- Micro-nano materials – design, testing and manufacture
- Ruggedised packaging

INFRASTRUCTURE

- Advanced Manufacturing Precinct (including Centre for Additive Manufacturing)
- Centre for Advanced Materials and Industrial Chemistry
- Centre for Innovative Structures and Materials and Centre for Lightweight Automotive Structures
- Centre for Materials Innovation & Future Fashion (textiles)
- Centre for Molecular and Nanoscale Physics and Micro-Nano Research Facility
- Low Temperature Co-fired Ceramic Facility
- Rheology and Materials Characterisation Facility and Vibration Spectroscopy Facility
- Microscopy and Microanalysis Facility and X-Ray Structural Determination Facility

TECHNOLOGY TRANSFERS

- Additive manufacturing and repair for Defence aircraft
- Anti-ballistic soft armour for Defence
- Advanced nanostructured fabrics
- Hybrid composite materials and structures

KEY PILLARS		
Advanced Sensors & Processing	• Modelling, Simulation & Analysis	
Big Data Processing & Visualisation	Multi-Disciplinary Material Sciences	•
Cyber & IT Security	Propulsion & Energy Storage	
Enhanced Human Performance & Protection	Quantum Technologies	
Hypersonics & Directed Energy Capabilities	Space Systems	
Integrated Intelligence, Surveillance & Reconnaissance	Sustainment	•
Medical/Pharma Technologies	Trusted Autonomous Systems	

CAPABILITIES

- Antenna design
- Broadband signal processing
- Embedded sensors and smart skin structures
- Photogrammetry
- Nano-photonics and photonic integrated circuits
- Remote sensing
- Sonar systems

INFRASTRUCTURE

- Applied Electromagnetics and Radiation Physics Group
- Centre for Advanced Electronics and Sensors
- Centre for Molecular and Nanoscale Physics
- Centre for Ultrahigh Bandwidth Devices for Optical Systems (CUDOS)
- Micro-Nano Research Centre
- RF Antenna Laboratory

TECHNOLOGY TRANSFERS

- Portable radar for DefendTex
- Human gas monitoring capsule
- Composite conformal antennae development
- Multi-static sonar systems
- Distributed continuous wave radar system
- Bragg grating fibre sensors for structural health monitoring
- Power lines – bush fire inspection

KEY PILLARS			
Advanced Sensors & Processing	•	Modelling, Simulation & Analysis	•
Big Data Processing & Visualisation		Multi-Disciplinary Material Sciences	
Cyber & IT Security		Propulsion & Energy Storage	
Enhanced Human Performance & Protection		Quantum Technologies	
Hypersonics & Directed Energy Capabilities	•	Space Systems	
Integrated Intelligence, Surveillance & Reconnaissance	•	Sustainment	
Medical/Pharma Technologies		Trusted Autonomous Systems	

CAPABILITIES

- Atmospheric modelling and monitoring
- Orbital mechanics
- Remote sensing
- Satellite tracking and positioning
- Space debris monitoring and modelling
- Space equipment and clothing
- Space situation awareness and space weather
- Space vehicle dynamics and attitude control

INFRASTRUCTURE

- Satellite Positioning Atmosphere, Climate and Environment Research Centre
- 400 mm optical telescope

TECHNOLOGY TRANSFERS

- Orbit determination of space objects
- Next generation space weather forecasts
- High accuracy real-time positioning

KEY PILLARS			
Advanced Sensors & Processing		Modelling, Simulation & Analysis	•
Big Data Processing & Visualisation		Multi-Disciplinary Material Sciences	
Cyber & IT Security		Propulsion & Energy Storage	
Enhanced Human Performance & Protection		Quantum Technologies	
Hypersonics & Directed Energy Capabilities		Space Systems	•
Integrated Intelligence, Surveillance & Reconnaissance		Sustainment	
Medical/Pharma Technologies		Trusted Autonomous Systems	•

CAPABILITIES

- Autonomous systems
- Modelling and simulation
- Optimisation and operations management
- Rapid prototyping
- Robotic systems
- Virtual design

INFRASTRUCTURE

- Autonomous Systems Laboratory
- Centre for Advanced Electronics and Sensors
- Centre for People, Organisation and Work
- Human Factors Engineering Laboratory
- Cognitive Human Machine Interaction Laboratory
- Unmanned Aircraft Systems Laboratory
- Virtual Experiences Laboratory

TECHNOLOGY TRANSFERS

- Autonomous aerial systems for applications in complex urban environments

KEY PILLARS			
Advanced Sensors & Processing		Modelling, Simulation & Analysis	•
Big Data Processing & Visualisation	•	Multi-Disciplinary Material Sciences	
Cyber & IT Security		Propulsion & Energy Storage	
Enhanced Human Performance & Protection		Quantum Technologies	
Hypersonics & Directed Energy Capabilities		Space Systems	•
Integrated Intelligence, Surveillance & Reconnaissance		Sustainment	
Medical/Pharma Technologies		Trusted Autonomous Systems	•

CAPABILITIES

- Aeroelasticity, aerodynamics and hydrodynamics
- Energy harvesting, alternate fuels, renewable energy and emissions reduction technology
- Hypersonic flight systems
- Remote and portable power systems, including hydrogen fuel cells and solar (photo voltaic) cells
- Ship anti-fouling
- Structural health monitoring (vehicles and infrastructure)
- Vehicle dynamics
- Virtual prototyping

INFRASTRUCTURE

- Air Traffic Management Research Laboratory
- Aircraft Systems/Autonomous Systems Laboratory and Flight Test Range
- Australia-India Research Centre for Automation Software Engineering
- Centre for Innovative Structures and Materials
- Flight Simulation Laboratory
- Internal Combustion Engines Laboratory
- Human Factors Engineering Laboratory

TECHNOLOGY TRANSFERS

- Ship dynamics and hydrodynamics
- Composite structure design
- Hydrogen fuel cells for portable power systems
- Alternative power packages for land vehicles
- Airworthiness procedures and training
- Platform technologies for space, atmosphere and climate
- CRC-P hypersonics fuel
- Computational aeroelasticity and dynamic load predictions

KEY PILLARS			
Advanced Sensors & Processing	•	Modelling, Simulation & Analysis	•
Big Data Processing & Visualisation		Multi-Disciplinary Material Sciences	
Cyber & IT Security		Propulsion & Energy Storage	•
Enhanced Human Performance & Protection		Quantum Technologies	
Hypersonics & Directed Energy Capabilities	•	Space Systems	
Integrated Intelligence, Surveillance & Reconnaissance		Sustainment	•
Medical/Pharma Technologies		Trusted Autonomous Systems	•

CAPABILITIES

- Trade, technical and professional skills and qualifications in STEM disciplines
- Post graduate teaching and research
- Commercial Pilot training (including flight instructor training)
- Business management and project management
- Short courses tailored for industry requirements
- Digital manufacture (Industry 4.0)
- Post-Defence transition to civil employment

INFRASTRUCTURE

- College of Business
- College of Design and Social Context
- College of Science, Engineering and Health
- Flight Training School (Pt Cook)
- School of Vocational Engineering, Health and Sciences

TECHNOLOGY TRANSFERS

- Reliability Engineering for ADF Engineers
- Aviation Maintenance Management Program
- Aviation Maintenance Engineer Program
- Army Logistics Training
- ADF Aviation Skills Upgrade Program
- Master of Engineering (Airworthiness)
- Advanced Diploma in Defence Procurement
- Small Business Management Transition Program

KEY PILLARS

Advanced Sensors & Processing	•	Modelling, Simulation & Analysis	•
Big Data Processing & Visualisation	•	Multi-Disciplinary Material Sciences	•
Cyber & IT Security	•	Propulsion & Energy Storage	•
Enhanced Human Performance & Protection	•	Quantum Technologies	•
Hypersonics & Directed Energy Capabilities	•	Space Systems	•
Integrated Intelligence, Surveillance & Reconnaissance	•	Sustainment	•
Medical/Pharma Technologies	•	Trusted Autonomous Systems	•



MULTIFUNCTIONAL MATERIALS & ADVANCED MANUFACTURING

RMIT University's Advanced Manufacturing Precinct focuses on additive technologies (3D printing), high-speed manufacturing and rapid prototyping.



SWIN
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SWINBURNE
UNIVERSITY OF
TECHNOLOGY

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Aviation training and human factors research.

RECOGNISED LEADERSHIP IN AVIATION EDUCATION AND AEROSPACE RESEARCH

Our research spans the breadth of the aerospace industry and its interrelated system of organisations, infrastructure, people, skills, information and activities. Swinburne has a proud pedigree in applying advanced manufacturing and materials research, utilising our world-class fabrication and testing facilities, to support the effective sustainment of military and civil aircraft and satellites.

For aviation operations, our researchers work with industry to understand how decisions are made in complex, fast-paced and safety-critical environments such as operations control centres and flight decks; how government policy and strategy shapes the industry as a whole; how fatigue and other safety concerns can be managed in crew; and how best to market an airline's product.

Through Swinburne's digital innovation research ecosystem, our globally recognised researchers work closely with the aerospace industry in areas such as data analytics, advanced visualisation, AI/machine learning, and cybersecurity to support downstream applications. Swinburne is also recognised as a world leader in astrophysics and space science: researchers have developed new tools for interactive visualisation and data analysis to enable exploration and presentation of multi-dimensional data, as well as the use of graphics processing units to accelerate computation.

Swinburne offers education in flying and aviation management, with courses developed and reviewed in consultation with key stakeholders in the aviation industry to ensure teaching is at the forefront of new developments. Our teaching staff have significant industry experience in international airline management, airline customer relationship management, flight crew, aerospace engineering and ground operations.



CENTRE FOR MICRO-PHOTONICS AND NANOTECHNOLOGY FACILITY

World class nanofabrication facilities with globally recognised research leaders partnering with industry to develop the next generation of advanced materials.

SWINBURNE UNIVERSITY OF TECHNOLOGY

swinburne.edu.au

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CAPABILITIES

- Materials and nanotechnology
- Physical chemistry
- Maritime engineering
- Human performance
- Data science and cybersecurity
- Advanced manufacturing, visualisation, modelling and prototyping

INFRASTRUCTURE

- Iverson Health Innovation Research Institute
- Aviation Simulation Laboratory – including Redbird and B737 simulators
- Energy Transformation Laboratory – 11m wave channel, microfluidics room, solar simulator, robot fish tank
- Smart Cities Research Institute
- Social Innovation Research Institute
- ANFF-Vic Biointerface Engineering Hub – spectroscopic ellipsometer, plasma polymerisation reactors
- High temperature processing facilities
- Centre for Sustainable Infrastructure – smart structures and geotechnical labs, hydraulic test facility

TECHNOLOGY TRANSFERS

- Optical fibre and electrical sensors for corrosion
- Corrosivity of Australian naval bases
- Bolt Electricity Storage Technology (BEST) – graphene based supercapacitor energy storage
- Improvement of the relationship between humans and automation in the aviation industry
- Ballistic and blast resistance of structures
- FDTD modeling of absorption of THz radiation in human skin
- Development of NDT techniques for in-field inspection of ceramic ballistic protection

KEY PILLARS		
Advanced Sensors & Processing	• Modelling, Simulation & Analysis	•
Big Data Processing & Visualisation	• Multi-Disciplinary Material Sciences	•
Cyber & IT Security	• Propulsion & Energy Storage	•
Enhanced Human Performance & Protection	• Quantum Technologies	•
Hypersonics & Directed Energy Capabilities	• Space Systems	•
Integrated Intelligence, Surveillance & Reconnaissance	• Sustainment	•
Medical/Pharma Technologies	• Trusted Autonomous Systems	•

SWINBURNE UNIVERSITY OF TECHNOLOGY – DATA SCIENCE RESEARCH INSTITUTE (DSRI)

Professor Timos Sellis
Director, DSRI
John Street, Hawthorn VIC 3122
Tel: +61 3 9214 8344
Email: dsi@swin.edu.au

swinburne.edu.au/research-institutes/data-science/about/

CAPABILITIES

- Data science and cybersecurity
- Novel methods for handling and analysing large and complex data sets
- Scalable hardware and software architectures
- Data visualisation
- Machine learning and statistics
- Spatio-temporal database systems

INFRASTRUCTURE

- Swinburne Supercomputer National Facility – Green II
- Swinburne Virtual Reality Theatre – stereoscopic 3D and 4K projection, colloquium system, Dolby
- Cisco Networking Laboratory
- Swinburne University Centre for Computing and Engineering Software Systems
- Centre for Astrophysics and Supercomputing

KEY PILLARS		
Advanced Sensors & Processing	• Modelling, Simulation & Analysis	•
Big Data Processing & Visualisation	• Multi-Disciplinary Material Sciences	•
Cyber & IT Security	• Propulsion & Energy Storage	•
Enhanced Human Performance & Protection	• Quantum Technologies	•
Hypersonics & Directed Energy Capabilities	• Space Systems	•
Integrated Intelligence, Surveillance & Reconnaissance	• Sustainment	•
Medical/Pharma Technologies	• Trusted Autonomous Systems	•

SWINBURNE UNIVERSITY OF TECHNOLOGY – MANUFACTURING FUTURES RESEARCH INSTITUTE (MFI)

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swinburne.edu.au/research-institutes/manufacturing-futures/

CAPABILITIES

- Advanced manufacturing, visualisation, modelling and prototyping
- New manufacturing processes for next generation materials
- Design driven manufacturing innovation
- Robotics and mechatronics
- Bio-devices and biotechnology
- Surface science
- Solar materials
- Business modelling and industrial automation

INFRASTRUCTURE

- Advanced Manufacturing and Design Centre
- Centre for Design Innovation
- Factory of the Future
- Design Factory Melbourne
- Microfabrication and microanalytical facility
- Nanofabrication laboratories
- Polymer processing and testing laboratories
- Direct metal deposition facility

KEY PILLARS		
Advanced Sensors & Processing	•	Modelling, Simulation & Analysis •
Big Data Processing & Visualisation		Multi-Disciplinary Material Sciences •
Cyber & IT Security		Propulsion & Energy Storage
Enhanced Human Performance & Protection		Quantum Technologies
Hypersonics & Directed Energy Capabilities		Space Systems •
Integrated Intelligence, Surveillance & Reconnaissance		Sustainment •
Medical/Pharma Technologies	•	Trusted Autonomous Systems

SWINBURNE UNIVERSITY OF TECHNOLOGY – DIGITAL RESEARCH INNOVATION CAPABILITY PLATFORM (DRICP)

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swinburne.edu.au/research/our-research/digital-capability-platform/

CAPABILITIES

- Agent-agent intelligent negotiation for collaborative learning and optimisation
- Adaptive cyber defence utilising AI / machine learning
- Scalable trustworthy system security, including IoT devices and cloud-based services
- Advanced data visualisation and contextualisation for 2D and 3D displays, VR/AR headsets and cloud-based systems
- Computer vision, image processing and video analytics, text mining and analytics, time-series analytics
- Distributed machine learning, including deep learning, ensemble learning and transfer learning
- Automating and optimising decision-making based on large-scale distributed, incomplete and imprecise data
- Development and integration of advanced IoT devices and robots, including real-time data analysis

INFRASTRUCTURE

- Advanced data visualisation laboratory
- Big data laboratory
- Cybersecurity laboratory
- Internet of Things (IoT) laboratory
- Software systems laboratory

KEY PILLARS		
Advanced Sensors & Processing	•	Modelling, Simulation & Analysis •
Big Data Processing & Visualisation	•	Multi-Disciplinary Material Sciences
Cyber & IT Security	•	Propulsion & Energy Storage
Enhanced Human Performance & Protection		Quantum Technologies
Hypersonics & Directed Energy Capabilities		Space Systems •
Integrated Intelligence, Surveillance & Reconnaissance	•	Sustainment
Medical/Pharma Technologies	•	Trusted Autonomous Systems •



THE UNIVERSITY OF
MELBOURNE

unimelb.edu.au

PRIMARY CONTACT

Professor Len Sciacca

Enterprise Professor – Defence Technologies
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CAREN: ENHANCED HUMAN PERFORMANCE

Australian first Computer Assisted Rehabilitation Environment (CAREN) Laboratory using biomechanical technology and virtual reality to treat real-world injuries.

THE UNIVERSITY OF MELBOURNE – RESEARCH OF SCALE FOR DEFENCE

The University of Melbourne conducts world-leading research into technologies and approaches which enable national defence systems to succeed in an increasingly complex security landscape.

Our internationally recognised aerospace systems include airflow and turbulent boundary analysis, fuel and propulsion systems, control and automation systems, all making use of cutting-edge laboratories. We have capability in autonomous systems research and expertise in swarm technologies, with large indoor test facilities. The University of Melbourne is also involved in satellite systems for earth monitoring and optical astronomy. Our research is critical to optimising the performance of aircraft dynamics, drag reduction, high speed aircraft control surface performance, offshore platforms, landing troops and amphibious operations, the performance of radar and sonar systems, and the through-life support of naval and aerospace platforms.

The University of Melbourne is home to a suite of world class research facilities such as large-scale air-wave interaction tanks; wind tunnels (including a high Reynolds number tunnel); ice, wind and wave modelling; access to real-world ocean infrastructure; and high-performance computing for aerodynamic and hydrodynamic simulation and modelling. At our new site at Fishermans Bend, the University is working with Defence Science and Technology Group, defence and other industries, and collaborating universities to create one of the most advanced maritime and aerospace research facilities in Australia, if not the world. The Fishermans Bend site will include autonomous systems experimentation facilities to support a new generation of platforms.



BIO21 MOLECULAR SCIENCE AND BIOTECHNOLOGY INSTITUTE (BIO21 INSTITUTE)

The Bio21 Institute is a multidisciplinary research centre specialising in medical, agricultural and environmental biotechnology.

CAPABILITIES

- Cognitive radio frequency systems – antennas, radar, signal processing
- Data science – managing large datasets, data mining, natural language processing, cloud computing
- Energy technologies – conventional and alternative fuels, energy efficient sea and air vehicles
- Nanoscience & materials – synthesis & nanoscale fabrication, molecular modelling & assembly of advanced materials
- Cognitive science – decision making, perception, attention, learning
- Bionics, neural interfaces, speech and vision processing, neuroengineering
- Military law, ethics, regulation of military technologies
- Mechanopharmacology, cell/tissue/organ on a chip technology for drug screening

INFRASTRUCTURE

- Melbourne Unmanned Aircraft Systems Integration – proximate remote sensing for research data acquisition
- Materials Characterisation & Fabrication Platform – advanced instrumentation, analysis and characterisation
- Magnetic Resonance Platform – detailed information on topology, dynamics and 3D structure of molecules
- Advanced Microscopy – atomic force, helium ion, fluorescence, electron, optical
- Particulate Fluids Processing Centre – rheometry, thermal, spectroscopic, particle and surface analysis
- Surface & Chemical Analysis Network
- Australian Integrated Multimodel EcoSystem (AIMES) – intelligent transport technology for smart cities
- Asia-Pacific Centre for Military Law

TECHNOLOGY TRANSFERS

- Australian Defence Apparel – Boron carbide ceramic lightweight body armour
- ASICS – shoe design to combat osteoarthritis of the knee
- Integra Systems – PunchIT Coil Line production system
- PolyActiva - improved polymer implants for medical applications
- Rio Tinto – Scheduling software for managing remote mining operations
- Moglabs – precision lasers
- MineOptima – software for the design of underground tunnel networks
- An@tomedia – self-paced learning program for the anatomy of the human body

KEY PILLARS		
Advanced Sensors & Processing	•	Modelling, Simulation & Analysis •
Big Data Processing & Visualisation	•	Multi-Disciplinary Material Sciences •
Cyber & IT Security	•	Propulsion & Energy Storage •
Enhanced Human Performance & Protection	•	Quantum Technologies •
Hypersonics & Directed Energy Capabilities	•	Space Systems •
Integrated Intelligence, Surveillance & Reconnaissance	•	Sustainment •
Medical/Pharma Technologies	•	Trusted Autonomous Systems •

CAPABILITIES

- Experimental and numerical studies of complex aerodynamics and turbulent flows
- Flow control, drag reduction strategies, aero-acoustic control
- Swarming of UAVs, multi-agent dynamics, networked dynamic systems, data-driven control
- Computational modelling for the design of lightweight alloys by additive manufacturing
- Optimal diesel engine and gas turbine engine performance
- Turbulent boundary layers – simulations, measurements and control
- Alternative fuels in gas turbines
- Interaction of ocean waves and structures

INFRASTRUCTURE

- Large-scale wind-tunnel facilities with flow diagnostic capabilities
- UAV swarm test facility
- High pressure combustion rigs, with detailed laser-based flow, temperature and combustion species diagnostics
- Proven in-house computational aerodynamics, aeroacoustics, aerothermal and combustion simulations
- Air-sea interaction (tow tank) facility
- Ice-air-sea interaction facility
- Optical engine
- Constant volume engine chamber test facility

TECHNOLOGY TRANSFERS

- Measuring and analysing vortex dominated flows for wings of fixed wing aircraft and helicopters
- Flow control for drag reduction
- Autopilot design for high speed air borne vehicles for defence
- Distributed UAV control for defence

KEY PILLARS		
Advanced Sensors & Processing	•	Modelling, Simulation & Analysis •
Big Data Processing & Visualisation	•	Multi-Disciplinary Material Sciences •
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Medical/Pharma Technologies	•	Trusted Autonomous Systems •

THE UNIVERSITY OF MELBOURNE – COMPUTER ASSISTED REHABILITATION ENVIRONMENT (CAREN)

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Enterprise Professor – Defence Technologies
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eng.unimelb.edu.au/industry/defence-technologies

CAPABILITIES

- Replicate and measure real life movement within a range of applied scenarios
- Measure real-time physical consequences of sensory inputs and outputs preceding intended and unexpected movement
- Analyse cognitive and physical impacts of equipment design
- Test and improve equipment to avoid injuries

INFRASTRUCTURE

- Multi-sensor and multi-sensory stimulating biomechanical laboratory
- Electromyography (EMG), electroencephalography (EEG) and functional near-infrared spectroscopy (FNIR)
- Immersive virtual reality-based environment

KEY PILLARS		
Advanced Sensors & Processing		Modelling, Simulation & Analysis
Big Data Processing & Visualisation		Multi-Disciplinary Material Sciences
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Enhanced Human Performance & Protection	•	Quantum Technologies
Hypersonics & Directed Energy Capabilities		Space Systems
Integrated Intelligence, Surveillance & Reconnaissance		Sustainment
Medical/Pharma Technologies		Trusted Autonomous Systems

THE UNIVERSITY OF MELBOURNE – CYBERSECURITY

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CAPABILITIES

- Network security and cryptography
- Anomaly and network intrusion detection
- Authentication and authorisation
- Distributed computing and peer to peer networks
- Network fault diagnosis
- Information security management
- Network auditing and accounting

INFRASTRUCTURE

- Academic Centre of Cybersecurity Excellence
- Cloud Computing and Distributed Systems Laboratory (CLOUDS)
- Spartan High Performance Computing-Cloud Hybrid System

KEY PILLARS		
Advanced Sensors & Processing		Modelling, Simulation & Analysis
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THE UNIVERSITY OF MELBOURNE – MEDICAL COUNTERMEASURES

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CAPABILITIES

- Public health preparedness and emergency response
- Epidemiology for disease surveillance and management
- Basic research to product
- Clinical research and international health
- Vaccines, drug discovery, drug delivery and diagnostics
- Environmental modelling and monitoring
- Synthetic and systems biology

INFRASTRUCTURE

- Significant databases of pathogens and genetic information
- Containment facilities
- Several research based hospitals

TECHNOLOGY TRANSFERS

- Significant contributions to international bodies such as WHO
- Addressed several tropical diseases – including malaria
- 35 clinical trials for viral infections – including HIV, Hep B, Hep C and cytomegalovirus
- Developed polymer based drug for antimicrobial resistant pathogens

KEY PILLARS		
Advanced Sensors & Processing	Modelling, Simulation & Analysis	•
Big Data Processing & Visualisation	Multi-Disciplinary Material Sciences	
Cyber & IT Security	Propulsion & Energy Storage	
Enhanced Human Performance & Protection	Quantum Technologies	•
Hypersonics & Directed Energy Capabilities	Space Systems	
Integrated Intelligence, Surveillance & Reconnaissance	Sustainment	
Medical/Pharma Technologies	Trusted Autonomous Systems	•

THE UNIVERSITY OF MELBOURNE – MELBOURNE INFORMATION, DECISION & AUTONOMOUS SYSTEMS (MIDAS)

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CAPABILITIES

- Networked dynamical systems
- Human centric autonomous systems
- Legal and societal implications for autonomous systems
- Sensor and information processing
- Control system design and implementation
- Advanced sensor design – nano and micro sensors
- Robust communications and sensor networks

INFRASTRUCTURE

- Swarm land and UAV laboratories
- Multi-modal robotics
- Robotic manipulators (Hand)

TECHNOLOGY TRANSFERS

- Optimal platform and controller designs for defence industry
- World first web mapping system
- Mine planning algorithm for world's largest iron ore mine
- Radar on chip technology

KEY PILLARS		
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Integrated Intelligence, Surveillance & Reconnaissance	Sustainment	•
Medical/Pharma Technologies	Trusted Autonomous Systems	•

THE UNIVERSITY OF MELBOURNE – MULTIDISCIPLINARY MATERIALS

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CAPABILITIES

- Integrated computational materials and engineering
- Blast protection materials
- Advanced diamond science
- Drag reduction surfaces
- Ceramics, polymers and metals
- Biofunctional, nano-medicine and medical implant materials
- Auxetic, meta and nano-photonics materials
- Organic electronic materials

INFRASTRUCTURE

- Materials characterisation and fabrication platforms
- Clean-room nano and micro device fabrication
- Melbourne Advanced Microscopy including electron and biological optical platforms
- Advanced fluorescence imaging
- Advanced instrumentation, analysis and characterisation
- Melbourne Trace Analysis for chemical, earth and environmental sciences
- Bio21 Magnetic Resonance Platform
- Informatics, Melbourne Computation

TECHNOLOGY TRANSFERS

- Ceramic powder based rotors
- Ceramic armour for personal protective systems
- Blast protection modelling for defence environments
- 3-D printing of polymers, metal alloys and biomaterials

KEY PILLARS

Advanced Sensors & Processing	Modelling, Simulation & Analysis	•
Big Data Processing & Visualisation	Multi-Disciplinary Material Sciences	•
Cyber & IT Security	Propulsion & Energy Storage	•
Enhanced Human Performance & Protection	Quantum Technologies	•
Hypersonics & Directed Energy Capabilities	Space Systems	
Integrated Intelligence, Surveillance & Reconnaissance	Sustainment	•
Medical/Pharma Technologies	Trusted Autonomous Systems	•

THE UNIVERSITY OF MELBOURNE – MARITIME SYSTEMS

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CAPABILITIES

- Metocean modelling
- Spectral wave modelling and prediction
- Fluid-structure interactions
- Floating ice-wave-ship interactions
- Airflow over ships and structures
- Environmental modelling and monitoring
- Gas turbines for land/sea/air
- Diesel engines and alternative fuels

INFRASTRUCTURE

- Comprehensive metocean databases
- World's largest wave-air water tank
- Diesel engine test rigs
- Octane rating engine
- Constant volume chamber
- Wind tunnels
- Ice-wave-air tank

TECHNOLOGY TRANSFERS

- Reduced drag on bio-fouled ships
- Parametric hurricane models for off-shore industries
- Optimised submarine engine performance for DST Group

KEY PILLARS

Advanced Sensors & Processing	Modelling, Simulation & Analysis	•
Big Data Processing & Visualisation	Multi-Disciplinary Material Sciences	•
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Enhanced Human Performance & Protection	Quantum Technologies	•
Hypersonics & Directed Energy Capabilities	Space Systems	
Integrated Intelligence, Surveillance & Reconnaissance	Sustainment	•
Medical/Pharma Technologies	Trusted Autonomous Systems	•

THE UNIVERSITY OF MELBOURNE – QUANTUM INFORMATION

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physics.unimelb.edu.au/research/By-Area/quantum-information

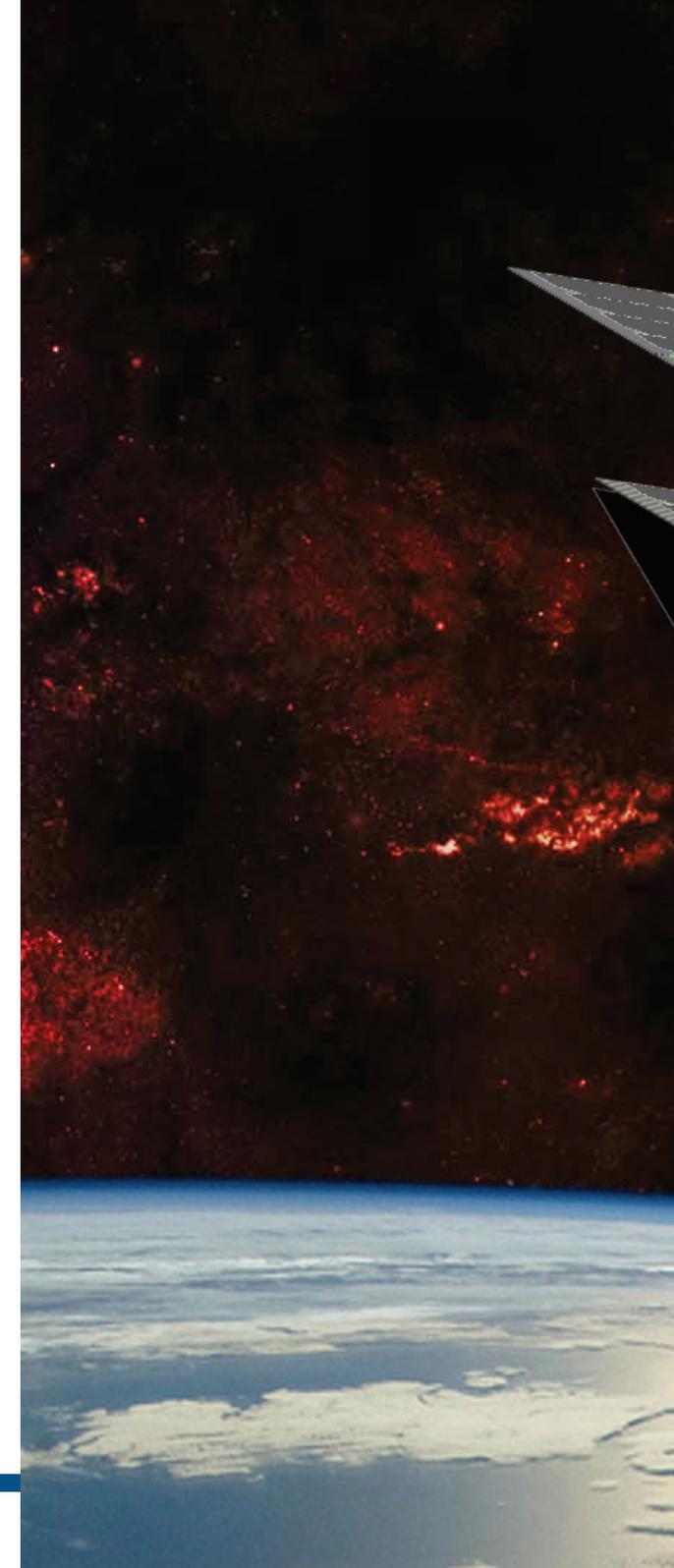
CAPABILITIES

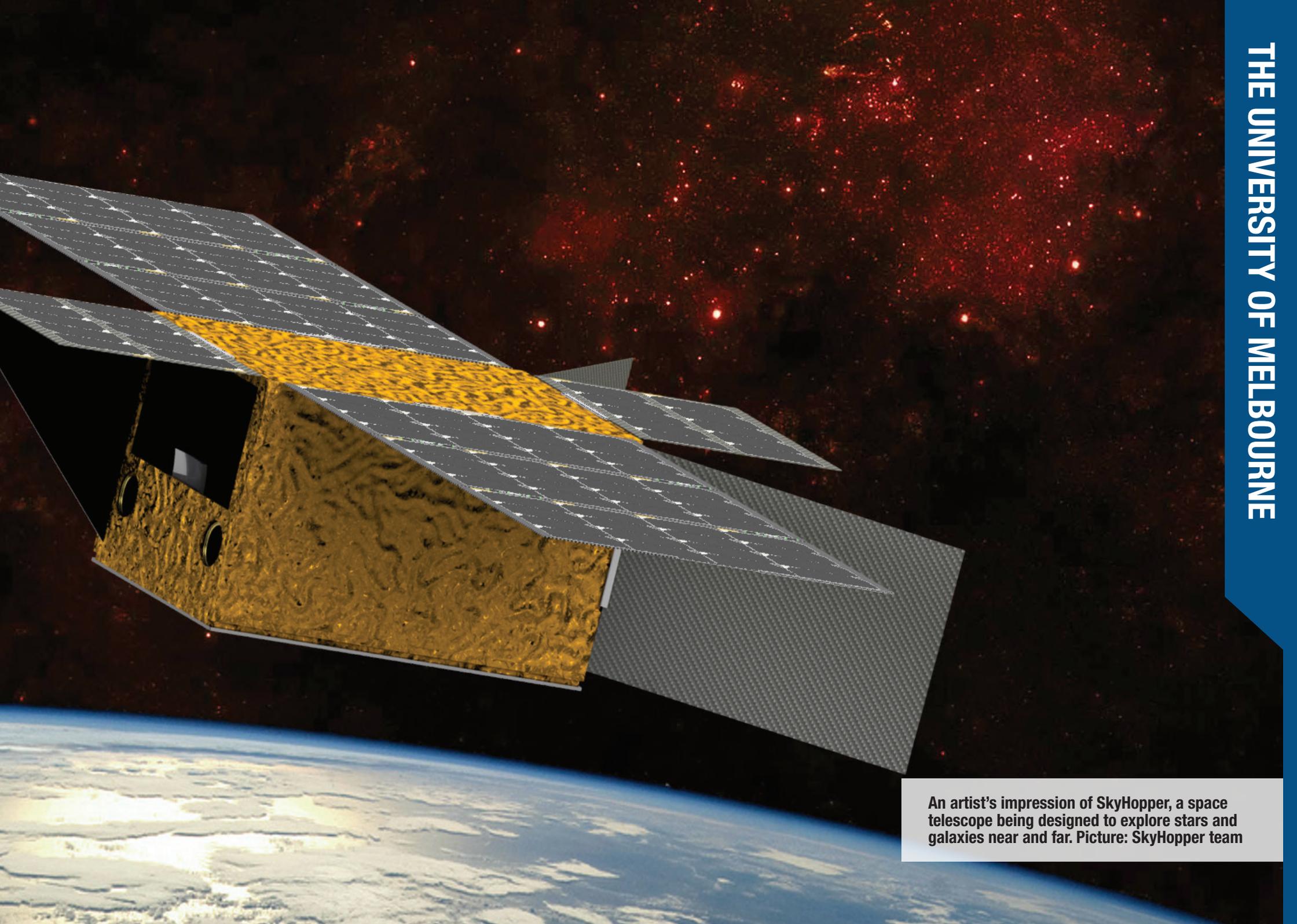
- Quantum computing and information processing
- Quantum device modelling and algorithms
- Quantum electronics (including dots and arrays)
- Quantum probes and sensing
- Quantum optics and imaging
- Quantum electrodynamics

INFRASTRUCTURE

- ARC Centre of Excellence for Quantum Computation & Communication
- Low-energy, nanometre-depth ion implanter (0.01 - 15 keV)
- MeV Ion Beam facilities – NEC 5U Pelletron (charging potentials up to 5 MV)
- Optical quantum measurement system
- Electron beam (EBL) and photolithographic processing facilities
- Orsay Physics focussed ion beam system with crossed e-beam SEM unit
- Leiden Cryogenics closed-cycle, cryogen-free dilution refrigerator
- Optical quantum measurement system

KEY PILLARS		
Advanced Sensors & Processing	•	Modelling, Simulation & Analysis
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An artist's impression of SkyHopper, a space telescope being designed to explore stars and galaxies near and far. Picture: SkyHopper team



**VICTORIA
UNIVERSITY**
MELBOURNE AUSTRALIA

vu.edu.au

PRIMARY CONTACT

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Vice-President Research (Acting)
research-funding@vu.edu.au

APPLIED ECOLOGY RESEARCH

Applied Ecology researchers of Victoria University are particularly well recognised in the areas of inland and coastal wetland management, impacts of marine tourism, orchids and waterfowl.

HUMAN CENTRIC RESEARCH AT VICTORIA UNIVERSITY

Victoria University (VU) is leading the way in human centric research with broad capabilities ranging from cell research to human performance research. The fully equipped \$52 million state of the art laboratories at Western Centre for Health Research and Education at Sunshine Hospital, a collaboration with the University of Melbourne, is primed for biological research with work focused on development and testing of vaccines and drugs for chronic diseases from cells, animals to translational clinical research. A \$65 million Sport and Exercise facility at Footscray Park houses laboratories for biomechanical testing, motor control, exercise science and genetics testing. Further facilities such as environmental chambers and an altitude hotel provide specialist capabilities for longitudinal experiments on human performance in various temperature, humidity and durational conditions. The planned \$1.2 billion Western Health hospital opposite the Footscray Park campus will provide deeper integration with biomedical research focused on critical chronic diseases and disorders.

VU is fast building networks with defence, having successfully delivered projects around human performance such as exoskeleton testing and genetics for future generation soldiers, and fire protection in submarines. The intrinsic focus on humans means that VU is well poised for collaborative aerospace research projects such as studies on the effects of flight on pilots and enhancing capabilities for humans in space. VU has close association with Defence Science Institute (DSI), Defence Science Technology Group (DST) and the Department of Jobs, Precincts and Regions (DJPR).



Prof. Vasily Novozhilov demonstrating high pressure water mist fire suppression capabilities.

VICTORIA UNIVERSITY

vu.edu.au

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CAPABILITIES

- Artificial intelligence and data mining for biomedical informatics, cybersecurity and environmental modelling
- Water and wastewater treatment – desalination & low pressure membrane systems, small-scale & industrial systems
- Thin film membrane design and characterisation for water purification
- Design of smart electronic systems integrating nanomaterial sensors, artificial intelligence in wireless comms
- High radio frequency wireless system design, testing and measurement

INFRASTRUCTURE

- Grid computing facilities and laboratories
- Facilities for tissue research, from cells, tissues to live animal testing
- Cell culture, biomaterials testing, advanced cell imaging and diagnostics
- Specialisations in enteric, nervous systems and vaccine development
- Facilities for thin film materials fabrication, physical and optical testing, electrical characterisation and modelling
- Laboratory and pilot membrane facilities for flat sheet, hollow fibre and ceramic membranes
- Fluid mechanics and hydraulics laboratory – pluviometers, flowmeters, water quality monitoring
- Telecommunications laboratory – wireless system design and RF signal propagation measurement (110 GHz)

TECHNOLOGY TRANSFERS

- Baseband coding for IEEE 802.11 b/g/n standards

KEY PILLARS		
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Enhanced Human Performance & Protection	•	Quantum Technologies •
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Integrated Intelligence, Surveillance & Reconnaissance	•	Sustainment •
Medical/Pharma Technologies		Trusted Autonomous Systems •

VICTORIA UNIVERSITY – AEROSPACE PROPULSION & FIRE SAFETY

vu.edu.au

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 Professor, ISILC
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CAPABILITIES

- Development and testing of new technologies for suppression of fires in spacecraft and satellites
- Solid propellants non-steady combustion modelling – ZN theory and CFD methods
- Solid propellant combustion testing – performance of existing and new propellant formulations
- Modelling and testing of hybrid propulsion systems for spacecraft launch/maneuvering
- Rocket engine combustion analysis – ZN theory and CFD methods
- Development and testing of water mist based suppression systems for fires involving aviation fuels
- Development and testing of suppression systems (water mist based and others) for protection of aircraft engines
- Collaboration with Japan Aerospace Exploration Agency (JAXA)

INFRASTRUCTURE

- Comprehensive range of small scale testing equipment for thermal and combustion properties of solid propellants
- Large scale high pressure (100 bar) water mist fire suppression system
- 3 MW Cone Calorimeter and ISO room for fire testing

TECHNOLOGY TRANSFERS

- Low pressure water mist fire suppression technologies

KEY PILLARS		
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Medical/Pharma Technologies		Trusted Autonomous Systems •

VICTORIA UNIVERSITY – INSTITUTE FOR HEALTH AND SPORT (IHES)

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vu.edu.au/research/institute-for-health-sport

CAPABILITIES

- Mechanisms of health disorders and developing appropriate interventions
- Developing clinical and community well-being programs
- Impact of human behaviour, social and policy changes that contribute to changes in health
- Techniques to enhance human sport performance in training, competition and business

INFRASTRUCTURE

- Biomechanics laboratory for human movement testing and measurement
- Biochemistry laboratory for tissue biopsies and gene testing
- Motor control laboratory for human performance testing
- Environmental chambers for human performance testing under pressure, temperature and humidity variation
- PCR capabilities for food, drug and DNA testing

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Integrated Intelligence, Surveillance & Reconnaissance		Sustainment
Medical/Pharma Technologies		Trusted Autonomous Systems

VICTORIA UNIVERSITY – INSTITUTE FOR SUSTAINABLE INDUSTRIES & LIVEABLE CITIES (ISILC)

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vu.edu.au/research/institute-for-sustainable-industries-liveable-cities

CAPABILITIES

- Fire and explosion dynamics – ignition, flammability, spread, flashover, deflagration, detonation
- Developing fire retardant functional polymeric and thermally resistant intumescent paints
- Cryptography and artificial intelligence for improved cybersecurity
- High frequency wireless RF measurement and characterisation capabilities eg 3G/4G/5G
- Thin film fabrication and testing for water membrane and various sensor technologies
- Counter terrorism research focused on human behaviour and techniques to detect violent extremism

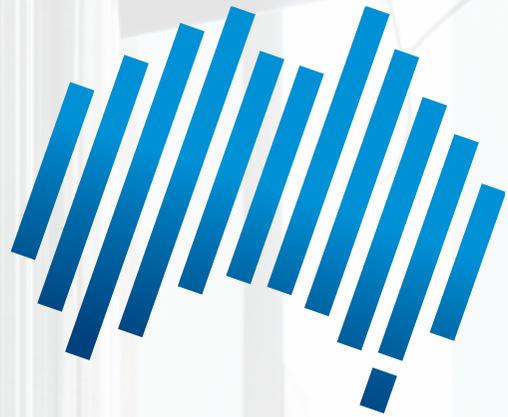
INFRASTRUCTURE

- Fire testing facility including large scale structural fire test furnace, cone and 3MW calorimeters
- RF measurement and characterisation into 60 GHz region
- Thin film sensor fabrication and characterisation
- Materials analysis equipment including XRD, FTIR, TGA/DSC, porosimetry, surface change, particle size

TECHNOLOGY TRANSFERS

- Implementation of low pressure water mist fire suppression systems
- Fire risk assessment for future submarine
- Smoke detector locations & effective notification via their interconnection
- Technology for membrane integrity monitoring
- Membrane processes for containment removal from waste water
- Image processing for abnormal prediction

KEY PILLARS		
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Medical/Pharma Technologies		Trusted Autonomous Systems



DMTC

dmtc.com.au

PRIMARY CONTACT

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MATERIALS TESTING

State-of-the-art engineering equipment at Swinburne University of Technology measures the performance of materials under triaxial load conditions. The results of these tests will inform the design of future generations of military vehicles. Source: DMTC Ltd.

DMTC – BUILDING CAPABILITY & CAPACITY IN AIR AND SPACE

DMTC has a demonstrated track record of delivering a range of key production, fabrication, manufacturing and sustainment technologies across the Air domain through a cost effective business model which leverages Defence investment by approximately 150% while retaining, for Defence, full control and ownership of all developed project intellectual property.

Research in DMTC's Air Program is currently focused on increasing the competitiveness of the manufacturing, repair and sustainment capabilities of Australia's defence industry. DMTC is working with industry partners, government research agencies and the University sector to enhance manufacturing and sustainment performance by developing new processing technologies and introducing global best practice.

The DMTC model for developing and exploiting intellectual property provides benefit for primes and SMEs alike. In the recent announcement that its Australian facility had achieved peak production of machining titanium parts for the Joint Strike Fighter program, BAE Systems Australia acknowledged DMTC's critical supporting role in delivering this important capability, and in identifying and developing a capable Australian supply chain. The preparatory work related to process optimisation and technology transfer was directed through DMTC's collaborative model.

DMTC is also working through its High Altitude Sensor Systems (HASS) Program to enhance Australian industrial capacity in sensor and on-board data processing technology for unmanned aerial systems and small satellite platforms. CSIRO's partnership with DMTC in this area is focused on niche capabilities aligned with Defence and national security priorities.



WELDING CAPABILITY

Wire arc welding is one of the additive manufacturing processes being advanced through DMTC's nationwide network of capable industry and research partners.

DMTC LIMITED

dmtc.com.au

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CAPABILITIES

- Foster enduring collaborative relationships between industry, research organisations, industry bodies and Defence
- Support Australian defence industry to be Defence-ready and reach global competitiveness benchmarks
- Reduced time to market and reduced investment required from Defence through our collaborative, co-investment model
- Ensuring Australian research expertise is targeted to achieving industrially-relevant outcomes
- Integrated supply chain approach to technology development ensures rapid adoption and tech transfer
- Active in all states across Australia, enhancing sovereign Defence capability through collaboration
- Breadth and depth of materials and manufacturing technology capability

INFRASTRUCTURE

- Access to a wide range of infrastructure & facilities at industry and research partners across Australia
- Fabrication, test and evaluation facilities
- Laboratories and research trial sites
- Blast test modelling and associated research facilities
- Additive manufacturing research equipment
- Welding technologies, robotics, automation and Non-Destructive Testing capabilities

TECHNOLOGY TRANSFERS

- Strong focus on utilisation & adoption by industry, particularly SMEs
- Robotic automated off-line programming for manufacturing
- Process optimisation and technology transfer relating to Australian titanium machining capability & supply chain
- Corrosion monitoring, management and control systems
- Industry Capability Development program in partnership with CDIC and relevant certification partners
- Digitisation and IoT concepts in manufacturing

KEY PILLARS

Advanced Sensors & Processing	•	Modelling, Simulation & Analysis	•
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Pathology lab on a chip.



OCSC

Oceania Cyber Security Centre

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OCEANIA CYBER SECURITY CENTRE (OCSC)

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CAPABILITIES

- Security by Design for Critical Infrastructure and the Internet of Things
- Verification – security, automated software, software vulnerability detection, protocol verification
- Advanced Cryptography – ID-based, post-quantum, homomorphic, low-resource, blockchain
- Social Media and Information Security – privacy, surveillance
- Network Security – automation & monitoring; event detection, analytics
- Big Data – machine learning & security, security analytics
- Robust and Resilient Automation and Industrial Control Systems
- Cyber Physical Systems Vulnerability Modelling

INFRASTRUCTURE

- Access to a wide range of infrastructure through partner universities, research organisations and industry
- Part of the Victorian cyber security cluster at Docklands

TECHNOLOGY TRANSFERS

- Focus on working with industry and government on keeping information secure and future-proofing the community
- Provision of advice on current and future cyber security threats
- Training and education on the latest security protection tools and techniques
- Development of tools and techniques for use by industry and government

KEY PILLARS			
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Learn more about Victorian research capability:

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defence science institute
Creating Defence Science Research Networks for Australia