



Australian Government

Department of Defence
Science and Technology

Defence Science and Technology Capability Portfolio



DST Science and Technology for Safeguarding Australia



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Message from the Chief Defence Scientist



Welcome to the second edition of the Science and Technology Capability Portfolio. Excellence in science and technology continues to be fundamental to an agile, innovative, capable and modern Australian Defence Force. Defence, through Defence Science and Technology (DST), maintains a strong portfolio of science and technology capabilities across a wide spectrum of military domains and operations.

This publication captures Defence's Major Science and Technology Capabilities (MSTCs) and aims to serve as a valuable resource for our partners and external stakeholders. Each of DST's MSTCs is independently reviewed by a panel drawn from national and international experts. Since 2015, every MSTC in DST has been externally reviewed. As part of these reviews, the panel members identified capabilities which are world-leading or world-class.

World-leading capabilities are those in which the science is at the leading edge internationally, there are significant and regularly received citations and awards, and the science excellence is not dependent on the expertise of a single person in the team. World-class capabilities are those where the staff undertake high quality original science, are published in leading journals and conferences, and are supported by recognition in the form of awards, citations or similar accolades. Examples are provided in this publication.

Achieving and maintaining excellence in science underpins the quality of the independent advice that we provide to Government. Defence values science excellence for its contribution to saving lives; enhancing effectiveness; reducing and mitigating strategic and operational risks; and maintaining a capability edge.

Partnerships with industry, academia and government agencies – national and international – are essential to strengthen and supplement Defence's capability and technology base.

We trust that you will continue to make good use of the information contained in this publication. It provides clear evidence of the quality of our science and technology base that we hope will inspire industry and academia to continue partnering with us, ensuring growth of Defence capabilities for the future.

Dr Alex Zelinsky
Chief Defence Scientist

Introduction

Science and technology plays a critical role in safeguarding Australia's defence and national security. Defence Science and Technology has been supporting the Australian Defence Force for more than 100 years with innovative solutions to deliver the capability edge.

DST's distinctive value, delivered through its various roles, is to ensure that Defence can both prevent and create strategic surprise by the application of innovative technologies through a multidisciplinary approach.

This value is derived from the combination of DST's unique world-class sovereign capabilities, its deep knowledge and responsiveness to the Australian defence environment, its active collaboration with the best partners nationally and internationally, and its ability to combine these elements to deliver soundly based independent advice.

DST is managed in terms of Major Science and Technology Capabilities (MSTC). An MSTC consists of people, science and technology (S&T) knowledge, infrastructure, and partner relationships within an area of science and defence domain. Within each domain the science component consists of the specialist knowledge, skills and experience of staff combined with leading infrastructure and strategic partnerships with industry and academia. The defence component is the context in which the specialist knowledge and experience have impact.

The scientists, engineers and technical specialists working in these MSTCs are supported by the skills of staff in the three corporate divisions who deliver science policy and strategy; frameworks for science partnerships and external engagement; enabling research services such as computing, safety and security; as well as finance and human services shared across Defence.

The contents of this document are intended to demonstrate the S&T capabilities developed by DST and to provide a starting point to further our external engagement.



Science excellence

“Science and technology excellence within Defence is demonstrated by the highest international standards for scientific and technological innovation, rigour, original contribution and influence, whilst solving the most challenging and valued problems.”

These are the terms that Defence uses to define science excellence. The principles and characteristics of science and technology excellence incorporate three nested layers: the individual researcher; the MSTC; and the organisation as a whole. DST will ensure success in achieving this excellence through a number of activities governed by a set of eight principles:



Principles

Characteristics

We achieve our goals and they have impact

Our S&T achieves high quality, high value Defence and national security outcomes

We test our quality against world benchmark standards

We undergo external quality reviews by independent experts at regular intervals. Staff contribute to symposia, colloquium, conferences, teaching/lecturing

We share and test our ideas with peers

We actively collaborate with internationally recognised research institutions, defence R&D organisations, and actively contribute to conferences, publications and symposia

We have ongoing professional development

Every person has a learning and development plan

We publish our work at the highest level

Staff publish unclassified work in leading refereed journals. Staff publish classified work in client or technical reports

We shape and develop defence S&T capability and build the talent pool for the future through engagement with academia

Staff are active members of collaborations with universities

We deliver value through transition of S&T from the laboratory to a defence capability

Staff are active members of collaborations with industry

We employ continuous improvement practices

We undertake reviews of our capability and outcomes



External MSTC review and technical benchmarking

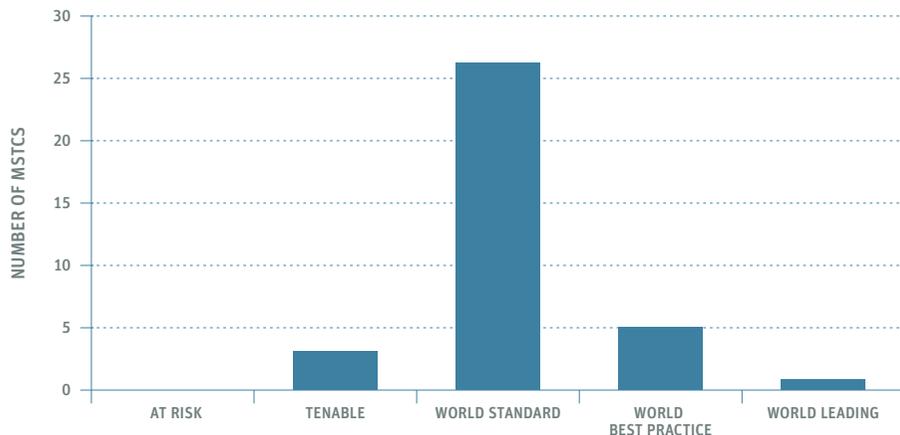
DST aims to be a national leader in safeguarding Australia by delivering scientific advice and innovative technology solutions for Defence and national security. To achieve this, it is essential that DST maintains capabilities that meet best practice in scientific, technical, professional and governance standards. In 2015, DST instigated a quadrennial external review process of benchmarking the performance of its MSTCs to help assure quality. Each review is conducted by a panel of experts drawn from eminent scientists and industry leaders around the world. Each review panel typically spends five days with an MSTC touring the laboratories to gain a deeper understanding of the science and the client program, and holding discussions with the Research Leader, Group Leaders and members of the MSTC. The review panel provides its assessment against 22 specific questions covered against the following six broad categories: Strategy and Leadership; Delivery and Impact; Quality and Technical Review; Engagement and Partnering; Research Infrastructure; Innovation and Future Focus.

In addition to these assessments the review panel is requested to identify any world-leading, world-class and/or national standing capabilities that exist in the MSTC and provide comments on any other matters they believe are relevant to the health of the MSTC. Those areas which have been identified as world-leading or world-class are included on each MSTC's page.

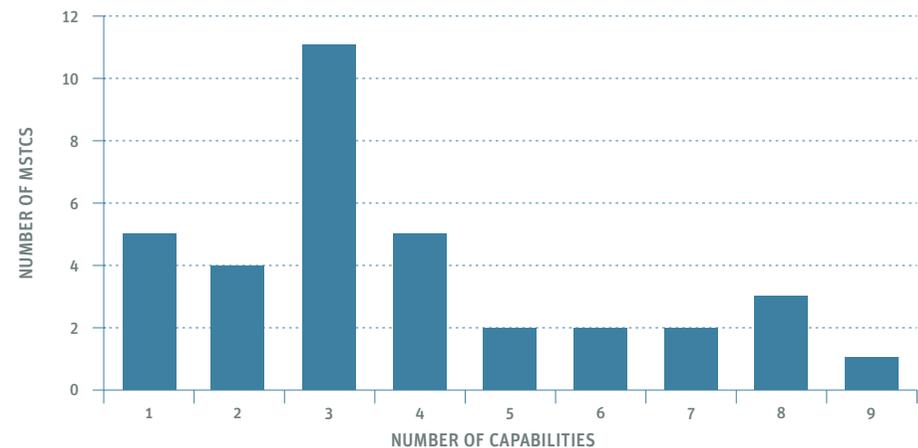
During the 2015–17 review, panel experts overall commented on:

- A high level of satisfaction among DST's clients, recognising the timely and effective efforts that had delivered numerous significant impacts
- Strong evidence of genuine engagement with key client groups and external collaborators from academia, industry and international Defence partners
- A strong track record for various mechanisms that fostered innovation and future-proofing Defence.

OVERALL RATING OF MSTC REVIEW



WORLD-CLASS CAPABILITIES





Partnerships

DST accesses and leverages world-leading science, technology, knowledge and innovation by collaborating with industry, academia and international agencies. Working closely with these partners ensures quality advice and innovative solutions for Defence and national security.

Science and technology partnerships also provide pathways for Defence innovations to be transferred to industry for commercialisation and the development of future capability.

DST has long-term strategic alliances with 14 defence primes and publicly-funded research agencies. These alliances are in addition to a number of individual collaboration agreements with technology companies and small business enterprises.

The Defence Science Partnerships framework has been developed for universities and Defence to conduct joint research under a standard agreement which provides cost efficiencies and time savings. More than 30 Australian universities are now partnering with DST under this framework, providing a larger research network to support Defence outcomes.

DST forms partnerships with defence research organisations overseas to access international capabilities that would otherwise not be available to the Australian Defence Force. The principal multi-lateral science and technology relationship is with the United States, United Kingdom, Canada and New Zealand under the Technical Cooperation Program. Joint research in niche capabilities is also undertaken with the Netherlands, Sweden, France, Japan, South Korea and Singapore.

DST leads the \$730 million Next Generation Technologies Fund which is a partnering program with a focus on developing future game-changing capabilities in collaboration with industry and academia.

Major Science and Technology Capabilities

Each MSTC comprises people, infrastructure, S&T know-how and partner relationships in a combination of a science and defence domain. The science component comprises the specialist knowledge, skills and experience of staff in the domain, as well as infrastructure and partnering. The defence component is the context in which our specialist knowledge, skills and experience have impact, including the particular physical aspect or operational context.

Corporate Divisions Responsible for corporate duties in order to shape strategic direction and enhance engagement with Defence and external partners.

Maritime Division (MD) Enhances ADF operations in the maritime domain through expert advice and solutions.

Land Division (LD) Provides support and solutions for ADF land capabilities by applying expertise in human sciences, vehicle and system sciences, personnel protection and chemical, biological and radiological defence.

Aerospace Division (AD) Provides support and solutions to enhance the operational effectiveness, performance, survivability, availability and safety of ADF aerospace capabilities.

Joint and Operations Analysis Division (JOAD) Undertakes rigorous, scientifically-based analysis of Defence operations and capability to provide independent, impartial, timely advice.

Cyber and Electronic Warfare Division (CEWD) Provides expert advice and technology solutions in the cyber domain and electronic warfare environment.

Weapons and Combat Systems Division (WCSD) Applies science and technology to the development and operation of highly effective weapon and combat systems for Defence.

National Security Intelligence Surveillance and Reconnaissance Division (NSID) Enhances the national capability for accurate, relevant and timely actionable intelligence for Defence and Government decision makers.

Science Strategy and Program Division Develops science policy, formulates Defence S&T and strategic research programs, and oversees risk management and resource investment into S&T capabilities.

Sonar Technology and Systems Conducts leading research and development in undersea acoustic sensors and systems to grow the ADF's undersea warfare capability.

Land Human Systems Develops, sustains and applies the broad cross-section of human science skills in support of ADF land operations.

Aerospace Systems Effectiveness Supports Defence outcomes in capability, efficiency and safety by providing advice and solutions where humans and air platforms or systems interact.



Cyber Assurance and Operations Supports enhanced performance in the presence of threats and unauthorised activities on computer resources.

Tactical Systems Integration Conducts research into tactical-information; architectures; integration and interoperability; automation; and processing to achieve distributed tactical decision superiority for the ADF.

Intelligence Analytics Develops situational awareness capabilities for intelligence analysts and conducts domain-specific research into human, open-source and all-source analysis techniques.



Acoustic Signature Management Delivers S&T solutions to manage the acoustic signature of defence platforms; and the hydrodynamic and manoeuvring performance of ships and submarines.

Land Vehicles and Systems Conducts research in vehicle systems management, armour and protection, logistics and integrated support systems.

Aircraft Performance and Survivability Conducts performance and survivability modelling and experimentation for flight, propulsion, signatures and stores carriage and clearances.

Aerospace Capability Analysis Enhances ADF aerospace capability by providing scientific advice informing acquisition decisions, supporting operations, and future-proofing Defence capability.

Cyber Sensing and Shaping Develops techniques for accessing, characterising and shaping communication networks to enable cyber operations.



Information Integration Supports the integration and application of intelligence, surveillance and reconnaissance systems.



Science Partnerships and Engagement Division
Coordinates and develops interactions with industry, academia, overseas agencies and other Australian government agencies. Promotes defence science in the education and wider Australian communities.



Research Services Division Delivers enabling services including science information management and technology, research infrastructure, scientific engineering and support, laboratory emergency management, safety and security.



Non Acoustic Signature Management Undertake research in materials science and technology to enhance the survivability, operational capability, seakeeping and cost of ownership of ADF platforms.

Maritime Autonomy Leads research into autonomous and unmanned systems to enhance ADF capability in maritime surveillance, mine countermeasures and rapid environmental assessment.

Undersea Command and Control Provides the ADF with scientific and technical expertise to enhance the RAN's undersea warfare capability and decision making.

Maritime Platform Performance Undertakes research in platform performance of materials, structures and systems to enhance the capability, survivability and safety of RAN vessels.



Chemical and Biological Defence Undertakes research and development of defence against chemical, biological and radiation threats.



Land Personnel Protection Supports soldier combat system development, and analysis of threats affecting the soldier.

Aircraft Health and Sustainment Supports aircraft health management systems and technologies, engine and fuel integrity, and aerospace systems sustainment analysis.

Airframe Technology and Safety Works to ensure aircraft safety and availability, reduce fleet cost of ownership and advises on acquisition projects.

Aircraft Structures Provides safety-critical aircraft structural integrity and airworthiness advice and solutions to the ADO.



Land Capability Analysis Informs Defence decisions on Land force structure and capabilities, focussing on operational effectiveness through applying and developing operations research methods, tools and techniques.

Maritime Capability Analysis Supports decision making on Navy's Force structure, concepts, acquisition of systems, operational effectiveness and capability management.

Joint Warfare and Operations Enhances and supports planning and preparation for, and employment of, the integrated joint force in current and future operations and enables ADF to achieve a capability edge in decision making at the strategic and operational level.

Strategy and Joint Force Informs Defence strategy development and the design and integration of the joint force by applying analysis, methodologies, experimentation, systems engineering and technology forecasting.

Assured Communications Provides solutions for robust communications in contested, complex and dynamic environments.

Systemic Protection and Effects Analyses and supports critical cyber physical systems, with respect to systemic electronic attack.

Spectrum Sensing and Shaping Supports enhanced situational awareness in complex radio frequency environments, and develops solutions for defeating the future networked EW, cyber and kinetic threats.

EW Operations Conceives, develops and validates countermeasures to defend ADF assets, and conducts fundamental research in laser technologies and systems.

Tactical Systems Performance Assessment
Conducts analysis of weapon system performance and end-to-end tactical system effectiveness.



Weapon Systems Technologies Strengthens ADF warfighting capability by applying the S&T of tactical perception, assured delivery of effects and electromagnetic interactions to weapons and combat systems.

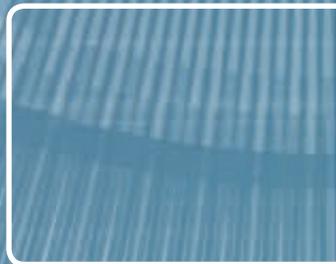
Energetic Systems and Effects Enhances Defence and national security capabilities, and the safety of ADF assets through research into energetic materials, explosive ordnance, propulsion technologies and high speed systems.

Intelligence Systems Develops intelligence systems for geospatial intelligence and measurement, signature intelligence, and imagery-based capabilities.

Surveillance and Reconnaissance Systems
Conducts research into surveillance and reconnaissance systems and assesses their application to Defence and national security needs.

High Frequency Radar Enhances long-range over-the-horizon radar as part of the national intelligence, surveillance and reconnaissance system.







Australian Government

Department of Defence

Science and Technology

Maritime Division

Sonar Technology and Systems

Goal

Develop and apply sovereign undersea acoustic sensing, processing and analysis expertise to provide the current and future ADF with regional superiority in acoustic undersea warfare.

Impact

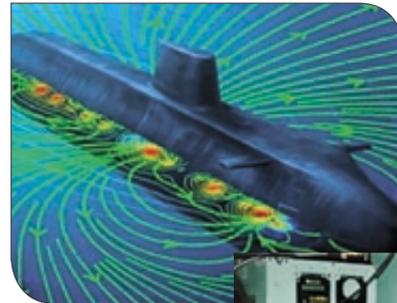
Sovereign USW S&T capability: The MSTC enables the ADF to maintain its capability edge against current and future undersea threats through targeted industry, academic and international partnerships in critical undersea sensor and sonar processing and visualisation technologies.

Next-generation sensor technologies: Our patented fibre-optic technology turns a single optical fibre into 32 hydrophones. Industry is using this technology in prototype towed and seabed acoustic sensor systems.

Collins and Future Submarine sonar: Advice and design output to Defence that leads to an enduring regional undersea acoustic superiority.

Airborne anti-submarine warfare: National and international collaborative R&D program provides Defence strategic planners with advice on future wide-area capability for theatre and task group scale airborne anti-submarine warfare (ASW).

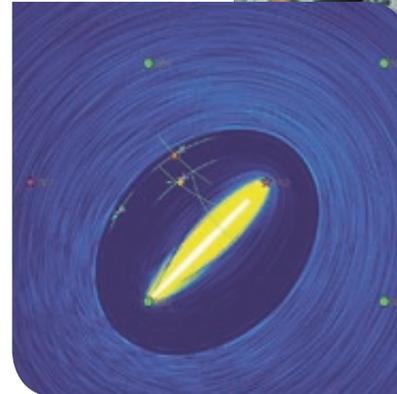
Sonar processing and visualisation: Our technology has been transitioned via Australian industry to improve operational sonars on RAN ships and submarines.



PASSIVE SONAR



ACTIVE SONAR



MULTI-SENSOR
ANTI-SUBMARINE
WARFARE

S&T excellence

THREE YEAR PUBLICATION RECORD

- 23 DST technical reports
- 17 DST client reports
- 13 Journal publications
- 43 Conference papers
- 1 PhD thesis

PEER RECOGNITION

- Adjunct positions: University of WA, Curtin University
- PhD supervision: University of WA, Curtin University
- National lead: TTCP MAR TP9

AWARDS

- University of South Australia – Sir William Goodman Mechanical Engineering Prize 2018
- Australian Transportation Safety Board MH370 Search Award 2017
- TTCP Achievement Awards 2014, 2016
- DST Awards 2013, 2015, 2017
- Australian Acoustical Society – WA Tertiary Prizes 2014, 2015

Partnerships and outreach

UNIVERSITIES

- Sydney University
- RMIT
- Adelaide University
- Flinders University
- University of WA
- Curtin University

INDUSTRY

- Thales (Aus)
- Ultra
- Raytheon
- Sonartech Atlas
- L-3 Oceania
- Boeing

GOVERNMENT

- CSIRO
- Bureau of Meteorology

INTERNATIONAL

- TTCP MAR Group
- NATO CMRE
- ONR, NUWC, NAVAIR (US)
- DTA (NZ)
- Thales (UK and France)
- Dstl (UK)
- University of Washington (US)

S&T capabilities

PASSIVE SONAR

The **Passive Sonar** group applies a deep understanding of how underwater sound is generated, propagated, sensed, processed and operationally employed to enable the ADF warfighter to detect, analyse and exploit the radiated signatures of the ocean's quietest threats.

ACTIVE SONAR

The **Active Sonar** group encompasses knowledge, skills and expertise associated with the techniques for projecting and sensing sound in the ocean and processing in real time the received 'echoes' from undersea objects, such as submarines. The group holds domain knowledge in Surface Ship ASW.

MULTI-SENSOR ANTI-SUBMARINE WARFARE

The **Multi-Sensor Anti-Submarine Warfare** group provides knowledge, skills and expertise in multi-sensor sonar signal processing, tracking and classification, which underpins the investigation, development, prototype demonstration and analysis of new and emerging techniques for enhanced ADF ASW capabilities. The group holds domain knowledge in airborne ASW.

World-class capabilities and infrastructure



FIBRE OPTIC ACOUSTIC ARRAY SENSORS

This capability will potentially change the direction of major projects and provide enhanced capability for the ADF. The work is backed by open literature publications and patents.

MULTI-STATIC SONOBUOY RESEARCH

This collaborative, international research program investigates sensor processing and scheduling for improved wide area search and localisation capability for multistatic sonobuoy fields. The work has resulted in many open literature, and other publications and underpins future ADF airborne and surface combatant multistatic ASW capability.



SUBMARINE SONAR SYSTEM MODELLING

The MSTC has developed a sonar modelling capability benchmarked and validated against the global best practice standards. The influence of insights provided through employment of this capability have confirmed DST's role as an authority in critical areas of major Australian maritime acquisition projects, such as the future submarine and future frigate.

Acoustic Signature Management

Goal

To control and manage the acoustic signature of RAN platforms providing increased operational effectiveness and improved survivability.

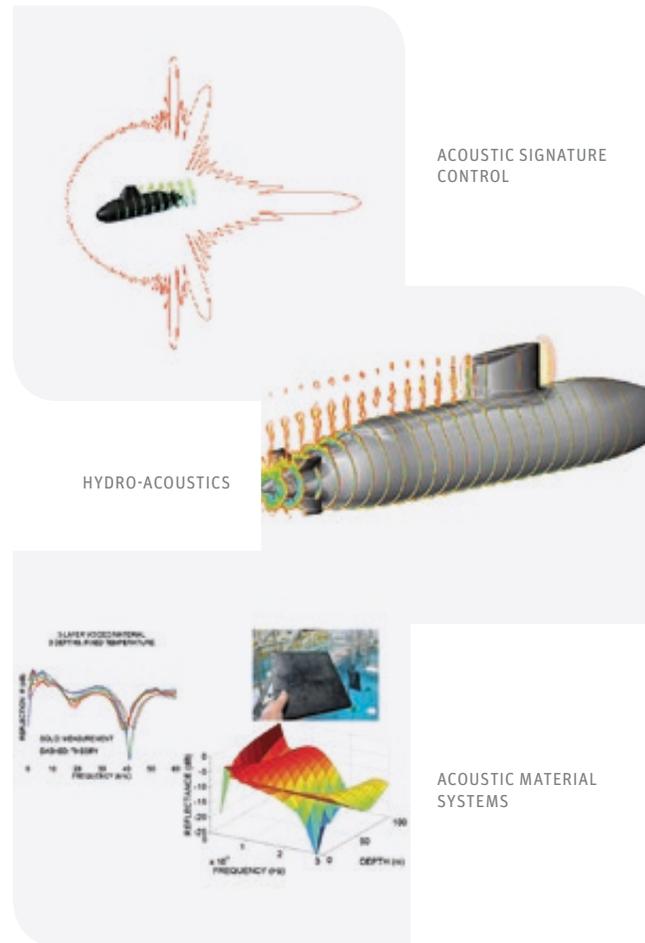
Impact

Anechoic tiles: New anechoic tiles have been developed to reduce submarine susceptibility to detection by active sonar threats, increasing the survivability and operational effectiveness of the platforms.

Acoustic signature monitoring: Partnering with industry a command decision aid has been developed to provide 'realtime' signature and susceptibility estimates providing greater situational awareness to the command team.

Platform acquisition: The provision of S&T advice on acoustic signatures and signature reduction to the new surface platform and submarine acquisition projects ensuring the new capabilities have regional superiority.

Submarine training: The development of new maneuvering and control models for the training simulator at Fleet Base West, improving the fidelity of operator training and reducing the onboard training requirement for new operators.



S&T excellence

THREE YEAR PUBLICATION RECORD

- 64 DST technical reports
- 85 DST client reports
- 36 Journal publications
- 72 Conference papers

PEER RECOGNITION

- 4 ARC grant reviewers
- Adjunct professors: UNSW, QUT, Australian Maritime College
- PhD supervisor: UNSW, QUT, UQ, UTas
- National lead: TTCP MAR Group TP4
- 4 Journal editors

AWARDS

- Minister's Award for Defence Science 2014
- SA Engineering Excellence Award 2013
- DST Awards: Outstanding Contribution to Collaborative Partnerships 2013, Outstanding Communication of S&T 2014, Science and Engineering Excellence 2016.
- Best Papers: Australian Academy of Science 2015; Institute of International Education 2015; Acoustic Emission 2014; Royal institution of Naval Architects 2016
- Best DST Student Project Award 2017

Partnerships and outreach

UNIVERSITIES

- University of Melbourne
- University of Tasmania
- University of Adelaide
- Queensland University of Technology
- University of WA
- University of NSW
- RMIT

INDUSTRY

- Frazer Nash
- Mackay Industries
- ASC
- QinetiQ
- L-3 Oceania

GOVERNMENT

- CSIRO

INTERNATIONAL

- TTCP MAR Group
- ATLA (Japan)
- NSWC (US)
- Defence Equipment and Support (UK)
- Dstl (UK)
- Centre for Ship Signature Management (Europe)
- MARIN (Netherlands)
- Swedish Defence Research Agency (Sweden)

S&T capabilities

ACOUSTIC SIGNATURE CONTROL

The **Acoustic Signature Control** group addresses the experimental investigation, modelling and analysis of passive and active acoustic signatures, to provide technology solutions for the control, reduction and management of the passive and active acoustic signature of ADF platforms.

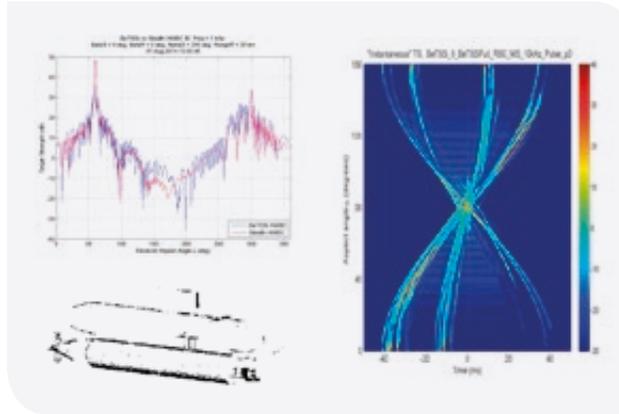
HYDROACOUSTICS

The **Hydroacoustics** group undertakes computational and experimental studies addressing hydrodynamic and manoeuvring effects on maritime platform design and operation. This includes the modelling or propeller and propulsor hydrodynamic and acoustic performance.

ACOUSTIC MATERIAL SYSTEMS

The **Acoustic Material Systems** group provides improved acoustic signature management through the application of advanced materials technologies, including the design of anechoic tiles and acoustic meta-materials.

World-class capabilities and infrastructure



CAVITATION RESEARCH TEST FACILITY

The Cavitation Research Test facility is a state-of-the-art facility that is utilised by many nations and the world-class research is apparent in terms of the collaborative publications and presence in international hydro acoustic conferences.

TARGET ECHO STRENGTH RESEARCH

The Target Echo Strength research is world-class, evidenced by strong international collaboration and deliberate allocation of research components across all participating nations.

COMPOSITE PROTOTYPING

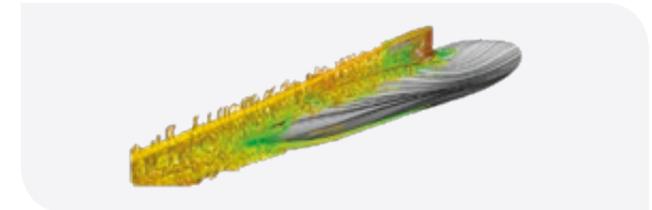
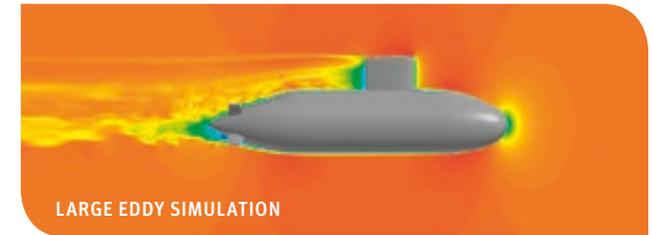
The rapid prototyping ability of composite structures and the understanding and ability to shape and change ideas in support of the acoustic materials research is very impressive.

COMPUTATIONAL FLUID DYNAMICS CLUSTER

The CFD group has a dedicated computational facility and it works in well with the focus on computational solutions – the people (both DST and academics) who work on this have created a hub of excellence. The cluster size is a world benchmark.

THE AUSTRALIAN SIGNATURE ASSESSMENT TOOL

AUSRAT tool is critical to SEA 1000 development and its ability to be incrementally refined to Australian defence requirements as the submarine design matures.



Non Acoustic Signature Management

Goal

To enhance the survivability and operational warfighting capability whilst reducing cost of ownership of ADF platforms through the use of materials science and technology.

Impact

Platform survivability: Reduce the radar reflection of platforms to radar detection by partnering with industry to design, manufacture and install radar absorbing material on ships, submarines and aircraft.

Safety: Leading the evaluation of chromate-free primers for aircraft (including F35) and a new isocyanate-free navy topcoat has led to a safer workplace for platform sustainment.

Operational capability: Design and application of materials to the electromagnetic interference shield on four frigate helicopters to significantly improve communication performance.

Platform acquisition: The provision of S&T advice on signatures and management technologies for SEA 1000, SEA 5000, LAND 400, LAND 121, AIR 6000 ensures enhanced survivability and regional superiority.

Cost of ownership: New anti-foul and durable coatings on ship hulls, superstructure and propellers has reduced RAN fuel consumption, in-water cleaning, and maintenance costs.



ELECTROMAGNETIC SIGNATURE CONTROL



SPECIALISED COATING TECHNOLOGY



ENVIRONMENTAL SIGNATURES AND PROTECTIVE SYSTEMS

CORROSION SCIENCES

S&T excellence

THREE YEAR PUBLICATION RECORD

- 46 DST technical reports
- 23 DST client reports
- 20 Journal publications
- 41 Conference papers

PEER RECOGNITION

- 2 ARC reviewers
- TTCP MAT Group National Lead
- Editor J. Computer Networks
- ONR Coatings Program reviewer

AWARDS

- Minister's Award for Defence Science 2013
- NATO STO & SET Panel Excellence Awards 2014
- Surface Coatings Association of Australia Lou Cash Memorial award 2016
- Defence Industry Innovation Award 2017
- Engineers Australia Excellence Award for Innovative R&D 2016
- DST Awards: Outstanding Early Career Achievement 2014, 2016, Outstanding Contribution to Defence Outcomes 2015, Technical Excellence 2014, 2016
- CDS Gold Level Commendation 2011
- Chief of Navy Silver Level Commendation 2012
- TTCP MAT Group Personal Achievement Award

Partnerships and outreach

UNIVERSITIES

- Swinburne University of Technology
- Deakin University
- University of Wollongong
- La Trobe University
- University of South Australia
- RMIT
- University of Melbourne
- Flinders University
- University of Queensland

INDUSTRY

- Mackay Industries
- BAE Systems
- ASC
- PPG, Akzo Nobel, Jotun, DEFT, Protec,
- Axalta,
- RUAG
- MacTaggart Scott
- DMTC

GOVERNMENT

- National Marine Science Committee
- NT & WA Departments of Fisheries
- Australian Institute of Marine Science

INTERNATIONAL

- TTCP MAT, AER and MAR Groups
- NATO SET Panel
- NRL, ARL (US)
- Dstl (UK)
- Atlas Elektronik, Ultra Electronics (UK)
- Lockheed Martin (US)
- TNO, MARIN, Phillips Lighting (NL)
- WTD 52 (Germany)

S&T capabilities

ELECTROMAGNETIC SIGNATURE CONTROL

The **Electromagnetic Signature Control** group provides a sovereign capability to enhance the operational effectiveness of current and future platforms through the control of radar, infrared and visible signatures.

SPECIALISED COATINGS TECHNOLOGY

The **Specialised Coatings Technology** group reduces the cost of ownership and enhances operational capability of ADF platforms through the development and specification of high-performance paint schemes and specialised sovereign signature management coatings.

ENVIRONMENTAL SIGNATURES AND PROTECTIVE SYSTEMS

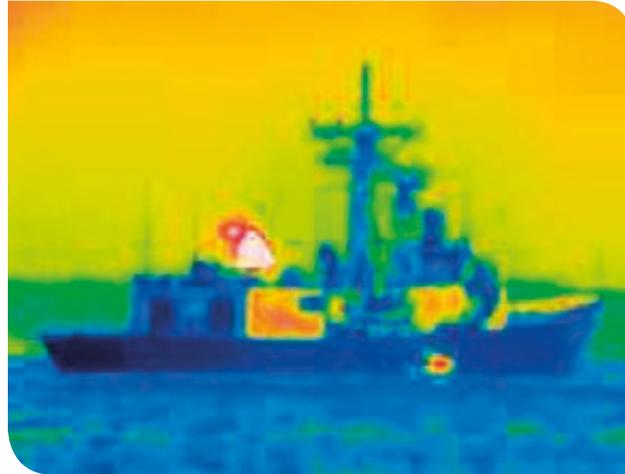
The **Environmental Signatures and Protective Systems** group enhances operational availability and reduces cost of ownership by providing capability in emerging environmental signatures and environmental aspects of seaworthiness.

CORROSION SCIENCE

The **Corrosion Science** group enhances the operational effectiveness, safety and availability, and reduces the cost of ownership of ADF ships, submarines and aircraft through optimum application of corrosion prevention technologies.

World-class capabilities and infrastructure

ENVIRONMENTAL SIGNATURE AND PROTECTIVE SYSTEMS

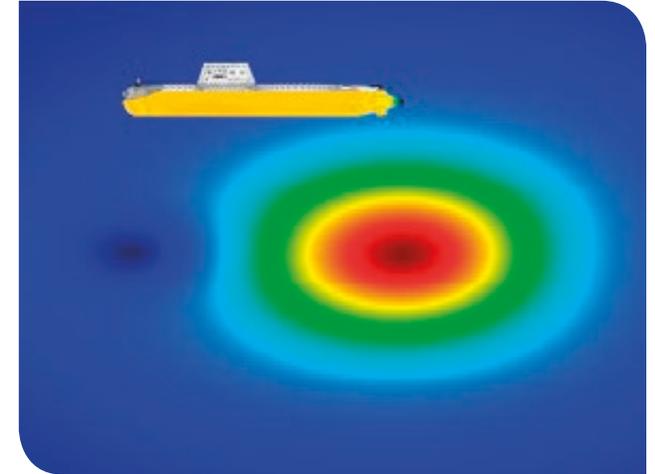


The scientific expertise in the Environmental Signatures and Protective Systems group and their collaboration is highly regarded by their international partners. The capability provides vital advice to government.

CORROSION SCIENCE

The Corrosion Science group, in rigour and output of scientific papers and international collaboration, would equal or exceed any international standards as a group.

SPECIALISED COATING TECHNOLOGY AND ELECTROMAGNETIC SIGNATURE CONTROL



Specialised coatings work and elements of the radar absorbing materials work are sovereign capabilities with excellent client delivery. The core capabilities in coatings and sealants are outstanding.

Undersea Command and Control

Goal

To improve ADF undersea warfare effectiveness through improving the collection, processing and exploitation of undersea tactical information by undersea platforms and systems.

Impact

Joint RAN-USN development: Improved performance of the MK 48 Heavy Weight Torpedo and the AN/BYG-1 Combat Management System by the insertion of Australian algorithms, displays and architectural techniques.

Collins Class submarines: Improved weapon control displays, periscope photography practice and operator training to increase submarine effectiveness.

Torpedo countermeasures: Developed and delivered improved signal libraries for RAN torpedo countermeasures.

Human systems integration: Expert input to SEA 1000 to enhance crew endurance, habitability and tactical information effectiveness of Australia's future submarines.

Optronics research: Increased understanding of detectability and performance of optronic systems through collaborative research and experimentation with the USA.

Signature and stealth: Environment and sensor modelling to inform signature and stealth requirements for SEA 1000 and SEA 5000.



UNDERSEA COMBAT SYSTEMS

HUMAN SYSTEMS AND INFORMATION INTEGRATION



UNDERSEA WEAPON SYSTEMS

UNDERSEA ENVIRONMENT AND WARFARE ASSESSMENT

S&T excellence

THREE YEAR PUBLICATION RECORD

- 11 DST technical reports
- 39 DST client reports
- 12 Journal publications
- 48 Conference papers

PEER RECOGNITION

- Adjunct Associate Professor, University of Adelaide
- 2 PhD Co-Supervisors

AWARDS

- Australia Day Medallion 2018
- USN NAVSEA Excellence Award 2014
- US Enterprise Integration Award 2015
- Curtin University Award 2016
- DST Award finalist 2014
- Human Factors and Ergonomics Society Conference Best paper 2014



Partnerships and outreach

UNIVERSITIES

- University of Adelaide
- University of Western Australia
- Edith Cowan University
- University of Melbourne
- RMIT
- University of South Australia
- Curtin University

INDUSTRY

- Lockheed Martin Aust.
- Raytheon
- Atlas Elektronik UK
- Ultra
- Thales
- BAE Systems (Aust.,UK)

GOVERNMENT

- CSIRO
- Bureau of Meteorology

INTERNATIONAL

- TTCP HUM and MAR Groups
- NUWC, NSWC, NAVSEA, PEOSUBS, ONR and SPAWAR (US)
- DRDC (Canada)
- Dstl (UK)
- DSTA (Singapore)

S&T capabilities

UNDERSEA COMBAT SYSTEMS

The **Undersea Combat Systems** group encompasses the development, analysis and testing of combat system architectures and techniques for the integration of sensors and sub-systems, and above water imaging systems, modelling and simulation and near surface propagation.

HUMAN SYSTEMS AND INFORMATION INTEGRATION

The **Human Systems and Information Integration** group encompasses the sciences required to analyse and improve the undersea warfare command team's information processing and decision making.

UNDERSEA WEAPONS SYSTEMS

The **Underwater Weapons Systems** group maintains and develops specialist knowledge of the functions, capability and information integration of undersea weapons and deployable systems.

UNDERSEA ENVIRONMENT AND WARFARE ASSESSMENT

The **Undersea Environment and Warfare Assessment** group encompasses the modelling and analysis of the undersea warfare effectiveness of Australian Defence Force platforms, and enables exploitation of ocean environmental knowledge for operational advantage.

World-class capabilities and infrastructure



DEVELOPMENT OF TRACKING ALGORITHMS

The fundamental research in tracking algorithms, including the incorporation of soft data, and target motion analysis automation is assessed as world benchmark.

CONTROL ROOM CONCEPTS AND OPTIMISATION

World benchmark capability for analysis of submarine control room concepts using novel techniques.

HEAVY WEIGHT TORPEDO DEVELOPMENT

The collaboration between DST and the USN on Mk48 torpedo guidance and control system development is producing a product that is assessed as world benchmark.

Maritime Platform Performance

Goal

To ensure current and future surface ships and submarines of the Royal Australian Navy are safe, efficient, sustainable and survivable for their desired operational envelope.

Impact

Sustainment: Partnering closely with Defence and industry has led to a substantial improvement in the structural integrity of the Armidale Class Patrol Boats.

Safety: Leading the technical investigation into the fire onboard HMAS Bundaberg has led to improvements in fire protection for the Armidale Class Patrol Boat fleet.

Platform acquisition: The development of performance and requirements analysis has shaped, and continues to shape, future acquisition projects such as the SEA 1000, SEA 5000, SEA 1180 and SEA 3033 programs.

Reducing cost of ownership: Improvements in understanding the life-of-type issues for Collins Class submarine hull valves has resulted in significant maintenance cost savings.

Sustainment: Successful investigation of mechanical and electrical failures resulted in the return-to-service of RAN submarines and surface ships.



NAVAL ARCHITECTURE
AND PLATFORM
SYSTEM ANALYSIS

NAVAL PLATFORM
SURVIVABILITY

DYNAMIC MILITARY LOADS



MATERIALS
PERFORMANCE
AND STRUCTURAL
INTEGRITY



POWER AND ENERGY SYSTEMS



S&T excellence

THREE YEAR PUBLICATION RECORD

- 47 DST technical reports
- 92 DST client reports
- 27 Journal publications
- 62 Conference papers
- 3 Book chapters

PEER RECOGNITION

- Adjunct Professor and 2 senior lecturer positions at University of Tasmania – Australian Maritime College and Monash University
- Advisory board members for University of Tasmania and Victoria University
- TTCP MAR Group National Lea

AWARDS

- Minister's Award for Defence Science 2017
- Defence Gold Commendation 2017
- DST Gold Commendation 2017
- Public Service Medal 2016
- Fellow of the Academy of Technological Science and Engineering 2016
- Best paper awards 2015, 2017
- TTCP Award 2015, 2017
- 2 DST Awards over the last 5 years

Partnerships and outreach

UNIVERSITIES

- University of Wollongong
- Flinders University
- Monash University
- University of Melbourne
- RMIT
- Deakin University
- Swinburne University

- Queensland University of Technology
- University of Tasmania – Australian Maritime College

INDUSTRY

- ASC
- DMTC
- Babcock

- Siemens
- Austal
- UTC Aerospace Systems
- Australian Marine Technologies
- ARC Training Centre in Fire Retardant Materials and Safety Technologies
- Pacific Marine Batteries
- GHD

GOVERNMENT

- ANSTO
- Australian Border Force
- Australian Federal Police

INTERNATIONAL

- TTCP MAR and MAT Groups
- Cooperative Research Navies
- MoD, Dstl, University of Greenwich (UK)

- ARL, ONR, NSWC, Virginia Tech (US)
- Department of Defence (France)
- DRDC (Canada)
- ABCANZ
- MARIN (Netherlands)
- Nordmetall (Germany)

S&T capabilities

NAVAL ARCHITECTURE AND PLATFORM SYSTEM ANALYSIS

The **Naval Architecture and Platform System Analysis** group provides Defence with objective evidence to support critical whole-of-vessel decisions related to safety, availability and performance of the present fleet, and for the informed selection of future capabilities.

POWER AND ENERGY SYSTEMS

The **Power and Energy Systems** group undertakes development, assessment, modelling, simulation, prediction and/or advanced control of maritime energy generation, storage and distribution systems for the ADF.

MATERIALS PERFORMANCE AND STRUCTURAL INTEGRITY

The **Materials Performance and Structural Integrity** group encompasses the development and evaluation of maritime materials systems and structural integrity assessment tools to ensure through-life structural integrity and minimise platform vulnerability of current and future RAN fleets.

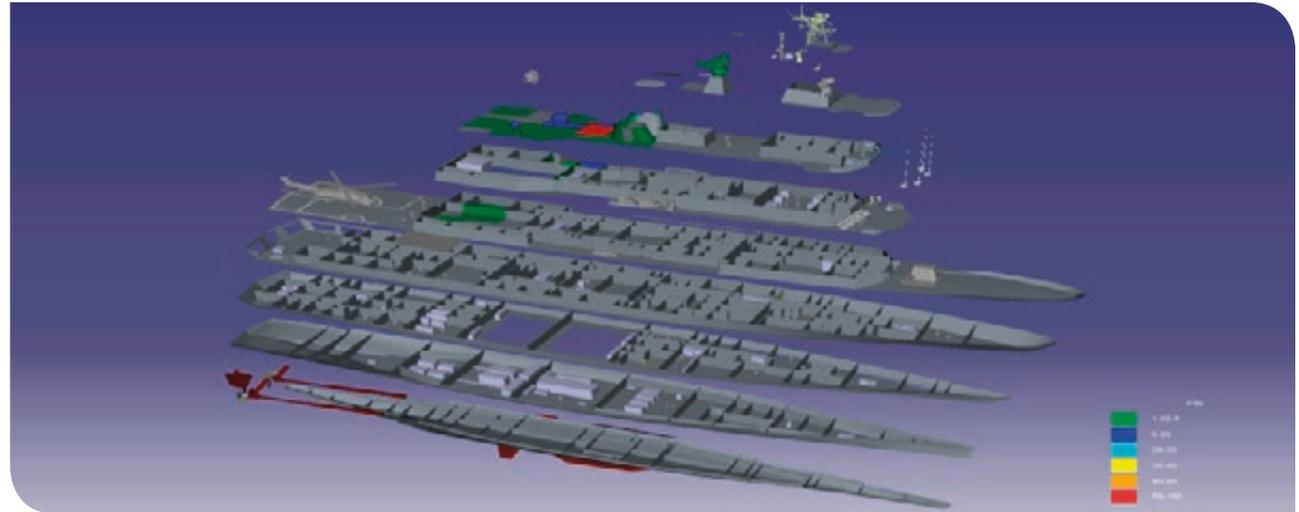
DYNAMIC MILITARY LOADS

The **Dynamic Military Loads** group assesses the performance of maritime platforms and systems against shock wave and other dynamic loading events from weapon attack.

NAVAL PLATFORM SURVIVABILITY

The **Naval Platform Survivability** group encompasses the modelling, analysis and experimentation of vulnerability, damage control and recoverability of maritime platforms against various combat/non-combat threats and incidents.

World-class capabilities and infrastructure



HYDRODYNAMICS OF HIGH-SPEED SLAMMING AND MULTI-SHIP HYDRODYNAMIC INTERACTION

Contributing to world-leading expertise through international collaborative programs related to the stability, seakeeping and loads of high speed craft, and the launch and recovery of manned and autonomous craft.

STRESS-CORROSION CRACKING AND MATERIAL EVALUATION

A world-leading capability by using a number of different testing approaches for submarine hull materials, with a notable number of externally refereed publications.

PLATFORM VULNERABILITY ASSESSMENT

World-leading research and facilities for platform response to weapons impact. Relied on for advice by Navy clients and international peers through the development of experimental, modelling and simulation capabilities.

FORENSIC INVESTIGATION INTO SHIP FIRES

Demonstrated best practice capability in providing scientific investigation and evidence-based decisions, ultimately leading to a Defence Gold Commendation.

INTEGRATED SURVIVABILITY

World-leading effort to provide an integrated survivability tool encompassing susceptibility, vulnerability and recoverability.

LITHIUM ION BATTERY RESEARCH

A very modern capability leading and collaborating with world-leading institutions to improve the technology field.

Maritime Autonomy

Goal

To enhance the ADF's maritime capability edge with smart sensors and uninhabited systems for undersea warfare and littoral operations.

Impact

Sovereign mine warfare capability: Unique scientific and technical knowledge of sea mine threats and platform signatures ensures safe passage of RAN vessels on operational deployment to possible mine threat areas.

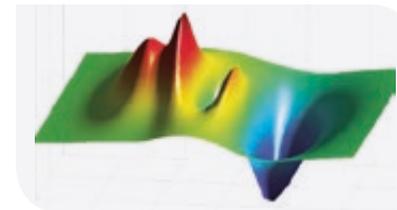
Concepts for uninhabited autonomous undersea operations:

Focused industry and academic partnerships enable the ADF to explore and evaluate new paradigms in off-board mine countermeasure and Rapid Environmental Assessment technology. This also supports major projects that are introducing uninhabited system such as SEA 1778, SEA 1770 and SEA 1180-2.

Sensor exploitation: The Maritime Autonomy MSTC investigates innovative solutions for integrating magnetic, acoustic and optical sensors to above, below and on water platforms which enhance RAN capability in ASW, MCM, hydrographic and amphibious landings.



UNMANNED SYSTEMS
AND AUTONOMY



MAGNETICS AND
PAYLOAD SENSORS

S&T excellence

THREE YEAR PUBLICATION RECORD

- 1 PhD thesis and 1 book chapter
- 7 DST technical reports
- 24 DST client reports
- 6 Journal publications
- 6 Conference papers

PEER RECOGNITION

- Adjunct Professor – Sydney University
- TTCP MAR TP13 National Leader
- Fellow of Acoustical Society of America
- Fellow of the Institute of Engineers Australia

AWARDS

- Minister's Award for Defence Science 2016
- Acoustical Society of America Silver Award (only non-American to win)
- TTCP Awards 2014, 2016, 2017
- DST Early Achievers award twice in last five years.

Partnerships and outreach

UNIVERSITIES

- Australian Maritime College
- Curtin University
- Queensland University of Technology
- University of Technology Sydney
- Sydney University
- University of NSW

INDUSTRY

- AADI Defence
- Boeing
- InSitu Pacific
- Kraken Systems
- Ocius, Ron Allum
- SAAB
- SFS
- Thales

GOVERNMENT

- CSIRO
- Bureau of Meteorology

INTERNATIONAL

- TTCP MAR Group
- ONR, NRL (US)
- US Army
- Rochester Institute of Technology (US)
- MIT (US)
- Atlas Elektronik UK
- ADD (Korea)
- DSTA (Singapore)

S&T capabilities

UNINHABITED SYSTEMS AND AUTONOMY

The primary focus in the **Uninhabited Systems and Autonomy** group is research and development of core autonomy algorithms and software to enable payload autonomy of uninhabited systems to be operated by the Navy.

MAGNETICS AND PAYLOAD SENSORS

The **Magnetics and Payload Sensors** group provides increased platform survivability through advanced management of underwater magnetic signatures and the employment of multiple sensor systems providing a unique capability for specialised maritime missions including MCM, hydrography and ASW.

World-class capabilities and infrastructure



PAYLOAD AUTONOMY

Payload autonomy is a world-class capability making significant contributions in NATO and TTCP.

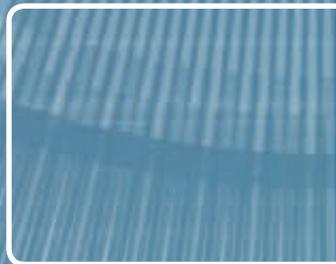
WORONORA DAM

The Woronora Dam measurement facility is a key national capability. Ongoing controlled access to the facility is a critical capability for Defence which should be maintained.



MINE SPECIAL PROJECTS

This facility and small team provide access to broader multinational knowledge and expertise, critical to Navy's MCM capability, that could not be generated and sustained alone as a national endeavour. This represents a significant capacity multiplier for MCM capability development and operational threat reduction.





Australian Government

Department of Defence
Science and Technology

Land Division

Land Human Systems

Goal

To enhance the warfighter and the human systems that select, prepare, equip, protect and sustain them to prevail in their mission and reset for the next.

Impact

Cognitively prepared: Research to meaningfully measure and practically enhance the selection and training of warfighters to cognitively outperform and outlast their adversaries.

Physically prepared: Research building on the MSTC's design and delivery of world-leading physical employment standards for all ADF trades to effectively select and efficiently train warfighters to achieve peak performance across diverse roles and under extreme conditions.

Nutritionally sustained: Driving innovation and quality in the design and provision of combat rations and fresh food, as the ADF's trusted experts on food and nutrition in a military context.

Augmented close combatant: Working closely with Army and Capability Acquisition and Sustainment Group through the Diggerworks partnership has delivered a world-class soldier combat system that continues to evolve to meet the emerging threats and opportunities for close combatant superiority.

Augmented vehicle occupant: Field and lab experimentation that reduce injury vulnerability and raise the human-system performance of Army's new combat vehicle acquisitions.



COGNITION AND BEHAVIOUR



PHYSICAL ERGONOMICS



FOOD AND NUTRITION

S&T excellence

THREE YEAR PUBLICATION RECORD

- 62 DST technical reports
- 85 DST client reports
- 47 Journal publications
- 98 Conference papers

PEER RECOGNITION

- Chair TTCP HUM Group
- Chair TTCP HUM JP1 Land Human System Performance
- National Lead TTCP LND TP5 Warfighter Survivability
- ICSPP17 Conference Chair
- Over ten university appointments
- Professional memberships held by the majority of staff

AWARDS

- Minister's Award for Defence Science 2015
- Comcare Work Health and Safety Award 2016
- College of Sport and Exercise Psychologists Award of Distinction 2016
- Traffic and Transport Psychology Young Scientist Award 2016
- APS College of Organisational Psychologists (SA) Award 2016
- DST Award 2017 – Partnership and Collaboration (HPRnet Team)

Partnerships and outreach

UNIVERSITIES

- Human Performance Research Network (HPRnet) – x7 Universities
- University of Wollongong
- University of Tasmania
- Griffith University

INDUSTRY

- Rheinmetall SA
- Cobalt Niche
- Myriota
- IMeasureU
- Alertness CRC

GOVERNMENT

- Australian Institute of Sport
- NSF (Australian Brain Alliance)
- CSIRO
- AFP
- SA Police

INTERNATIONAL

- TTCP HUM and LND Groups
- NATO STO
- DSTA, FSTD (Singapore)
- ARL, NSRDEC (US)
- DRDC (Canada)
- Dstl (UK)
- DTA (NZ)

S&T capabilities

PHYSICAL ERGONOMICS

The **Physical Ergonomics** group maintains an internationally respected capability in the fields of physiology, biomechanics and ergonomics, which is dedicated to the physical preparation and operational augmentation of the warfighter.



COGNITION AND BEHAVIOUR

The **Cognition and Behaviour** group leads the application of psychology to the design, integration and optimisation of those land systems for which mental performance and behavior is critical to success, with an emphasis on training for Army.

FOOD AND NUTRITION

The **Food and Nutrition** group maintains benchmark laboratory facilities and a long history of research focused on ensuring that ADF personnel are provided with the optimal food and hydration to achieve their military missions across a range of challenging environments, both on base and on operations.

World-class capabilities and infrastructure



PHYSICAL EMPLOYMENT STANDARDS

The Physical Employment Standards program has become an international model of best-practice for warfighter preparation that is being implemented across the ADF to enhance the physical performance and resilience of personnel.

DIGGERWORKS

Members of the Land Humans Systems capability were closely involved in the founding and ongoing support of the Diggerworks partnership. The branch was recognised for both its part in transforming the ADF's Soldier Ensemble into a truly fit-for-combat system, and for their contribution to designing and demonstrating an effective model of trusted partnership.



FOOD LABORATORY

The laboratory at DST Scottsdale was singled out as being world-class due to its combination of cutting-edge laboratory facilities, respected expertise and deep understanding of the military context, all leading to valued research outcomes for their military stakeholders.

Land Vehicles and Systems

Goal

To enhance the land force's ability to survive and succeed in challenging environments by delivering novel land system concepts and solutions.

Impact

Vehicle survivability: Through R&D in multi-role armour systems, predictive modelling, protective appliqué, improved materials and cabin survival systems, the ballistic and blast survivability of land vehicles and their crews have been enhanced.

Resilient mission systems: By developing distributed, contextually aware, adaptive and resilient vehicle hosted mission systems, the LVS MSTC has contributed to the reduction of the cognitive burden of operators and increased Australia's land vehicles potency.

Enhanced and survivable combat service support: Force element sustainability of land vehicles has been enhanced by the exploitation of distributed, networked and autonomous logistic technologies and supporting concepts.

Resilient tactical C2ISR information networks: Developing autonomous tactical information systems will enhance the information dissemination across disrupted, intermittent and limited communications with greater resilience, trust and quality of service with less reliance on the warfighter.

Decentralising tactical sensing: Leveraging commercial technologies for IoT and space-based communications to provide countless, remote and self-contained sensing devices to provide a wide-ranging tactical picture of complex operational environments.



S&T excellence

THREE YEAR PUBLICATION RECORD

- 50 DST technical reports
- 63 DST client reports
- 21 Journal publications
- 27 Conference papers
- 3 Book chapters

PEER RECOGNITION

- 5 PhD Supervisors
- 2 University adjuncts
- 1 Principal Scientist
- 1 Defence Science Fellowship
- 3 Journal reviewers
- 1 Chair of International Symposia
- TTCP LND Group
- NATO Panels

AWARDS

- Land Defence Australia Young Innovator Scholarship 2016
- DMTC Early Career Award 2016
- Commander CDG Gold Commendation 2014
- DST Achievement Awards 2016

Partnerships and outreach

UNIVERSITIES

- University of NSW
- RMIT
- Deakin University
- Melbourne University
- Adelaide University
- Monash University

INDUSTRY

- BAE Systems
- Defence Materials Technology Centre
- Thales Australia
- Ambrose
- Myriota
- Consilium

INTERNATIONAL

- TTCP LND Group
- Dstl (UK)
- ARL (US)
- DSTA (Singapore)
- NATO STO
- TARDEC (US)
- Ernst MachInstitut (Germany)
- Naval Postgraduate School (US)
- DRDC (Canada)

S&T capabilities

LAND VEHICLE SURVIVABILITY

The **Land Vehicle Survivability** group undertakes research into vehicle survivability. It partners with industry and academia to enhance the blast and ballistic protection of vehicles through research and the development of blast mitigation applique, multi-role armour and cabin survival.

ADVANCED VEHICLE SYSTEMS

The **Advanced Vehicle Systems** group undertakes research in partnership with academia to develop distributed, resilient vehicle-hosted mission systems that adapt to varying levels of contention within the environment, increasing the efficacy of those systems.

LAND SYSTEMS INTEGRATION AND TACTICAL NETWORKING

The **Land Systems Integration and Tactical Networking** group partners with academia, industry and the US Army Research Labs to research the application of computational intelligence to tactical information management implemented in the SMARTNet concept demonstrator.

LAND LOGISTICS

The **Land Logistics** group undertakes the research, development and exploitation of enhanced and survivable combat service support concepts and technologies, such as autonomous logistics, to enhance combat service support efficiency and survivability in complex environments.

World-class capabilities and infrastructure



BLAST AND BALLISTIC MODELLING

Key staff in the Land Vehicle Survivability STC are widely recognised and respected in the NATO and TTCP environments for the world-class capability that they have developed in blast and ballistic modelling. This capability has also contributed to DMTC activities and vehicle development activities in industry, and has ensured that new vehicle procurements for Defence such as Protected Mobility Vehicle (PMV-L) are afforded the highest practicable levels of protection.



Chemical and Biological Defence

Goal

Lead the application of biology, chemistry and related disciplines to inform, safeguard and mitigate the risk posed by chemical and biological threats to personnel and missions of Defence and national security organisations.

Impact

Support to operations: Provision of advice and training on chemical and biological (CB) hazards, personal protective equipment and treatments, detectors and decontamination systems has provided Defence with the capability to survive and operate within CB environments.

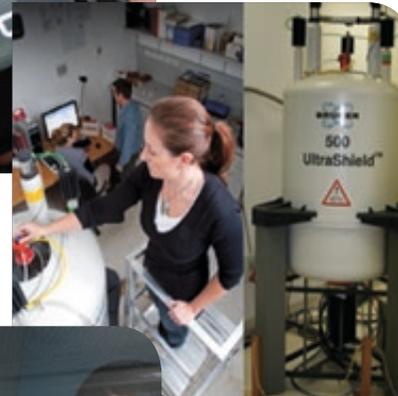
Support to acquisition: By assessing CB protective equipment, detectors and decontamination systems, this capability has been providing smart buyer advice to Defence.

Support to intelligence: Advice to Defence and national security agencies on hazards posed by CB agents has raised the understanding of threats to ADF personnel and operations, driving capability development.

Research and development: The application of R&D to develop niche solutions to provide Defence the technological edge to operate in CBRN environments now and into the future.



HAZARD MANAGEMENT AND INDIVIDUAL PROTECTION



AGENT CHEMISTRY AND VERIFICATION



BIO-AGENT IDENTIFICATION AND CHARACTERISATION

AGENT-BASED GENOMICS AND CELL BIOLOGY

THREE YEAR PUBLICATION RECORD

- 23 Journal publications
- 30 DST client reports
- 37 DST technical reports
- 23 Conference papers

PEER RECOGNITION

- 1 ARC assessor
- 2 PhD thesis assessors
- 1 PhD supervisor
- 4 DSF and 3 CDS Fellows
- 5 Journal reviewers
- Chair of the International CBR MOU
- 1 S&T advisor to the Australia Group
- Executive Committee members for CWALN
- National S&T lead for Medical Counter Measures Consortium
- 2 Chairs of International Symposia
- ISO and Australian Standard panels

AWARDS

- DST Collaborative Partnerships Award 2017
- DMTC Research Collaboration Award 2017
- CBR MOU Enduring Contribution Award 2017
- AUS Op Service Medal (Civilian) 2017
- AUS Service Badge Civilian 2017
- DST Technical Excellence Award 2017
- SP&I Award for Client Support 2016
- OPCW Hague award 2016
- DST Outstanding Corporate Contribution 2015
- DST Achievement Award 2015
- ANZSMS Bowie Medal 2013

Partnerships and outreach

UNIVERSITIES

- LaTrobe University
- University of Technology Sydney
- Monash University / Bio21
- Macquarie University
- Garvan Institute of Medical Research
- RMIT, University of NSW
- Swinburne University; Flinders University

INDUSTRY

- Catapult
- Ideation
- Defence Materials Technology Centre

GOVERNMENT

- CSIRO
- Defence Science Institute
- Army Malaria Institute
- Victorian Infectious Disease
- Research Laboratory
- Berrimah Veterinary Labs

INTERNATIONAL

- Chemical and Biological MOU
- Australia Group (forum for control of CBR weapons)
- Organisation for the Prohibition of chemical Weapons (OPCW)
- DRDC (Canada)
- Chemical and Biological Weapons Conventions
- CTTSO, US DHS (US)
- DSTA (Singapore)
- DTA (NZ)

S&T capabilities

AGENT CHEMISTRY AND VERIFICATION

The **Chemical Agent Characterisation and Assessment** group leads the application of R&D for the hazard assessment of highly toxic chemicals and verification of their alleged use.

BIO-AGENT IDENTIFICATION AND CHARACTERISATION

The **Bio-agent Identification and Characterisation** group leads the development, evaluation and application of biological detection and diagnostic platforms for use by ADF, emergency services and DST personnel.

AGENT-BASED GENOMICS AND CELL BIOLOGY

The **Agent-based Genomics and Cell Biology** group conducts cell biology and genomics research to investigate the mechanisms of action and hazards posed by chemical, toxin and biological agents, as well as evaluating novel medical countermeasures to those agents.

HAZARD MANAGEMENT AND INDIVIDUAL PROTECTION

The **Hazard Management and Individual Protection** group leads the application of R&D for the development of new materials for protection of individuals and decontamination or detection systems for specific chemicals of concern.

World-class capabilities and infrastructure



SCHEDULE 1 LABORATORY CHEMICAL AGENT ANALYSIS FACILITY

The only laboratory in Australia designated by the Organisation for the Prohibition of Chemical Weapons to produce chemical warfare agents for protective purposes and analyse environmental and biomedical samples for verification of alleged use.



LEVEL 3 BIOLOGICAL FACILITY

The Level 3 biological facility is used as containment for a range of biological warfare agents.

ENVIRONMENTAL TEST FACILITY

These three facilities are national assets which are sovereign capabilities and require expensive ongoing maintenance and specialised expertise to operate and maintain.

Land Personnel Protection

Goal

Inform, protect and enable the warfighter to improve survivability and mission effectiveness through advances in CBRN hazard analysis, physical protection systems, EM signature reduction and soldier-focused autonomy.

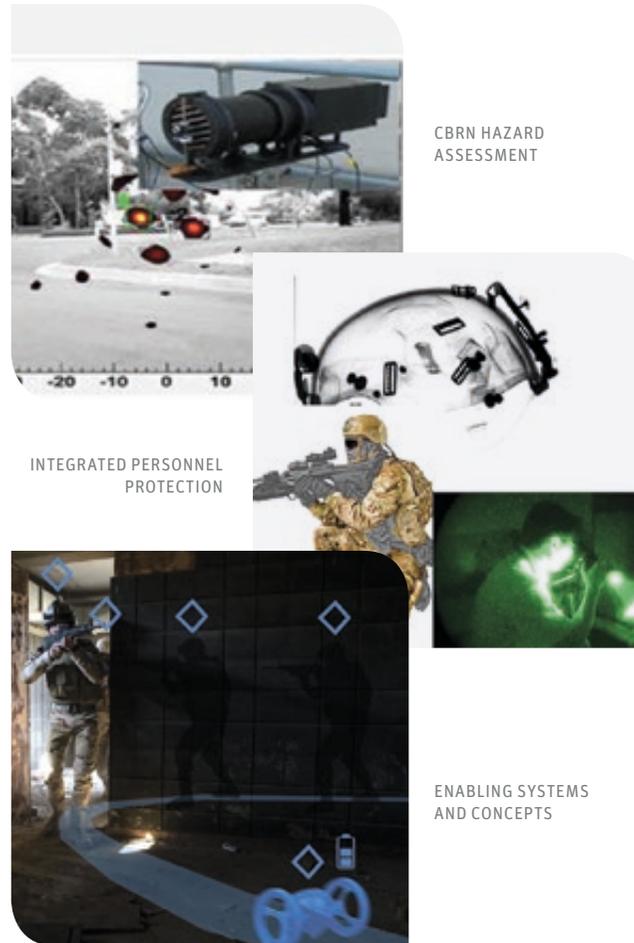
Impact

Support to operations: CBRN hazard modelling has optimised personnel protection and enhanced mission effectiveness for deployed ADF at threat from hazardous materials.

Force survivability: Improved camouflage and signature management for Army, and advice on current combatant ballistic protection, have enhanced survivability of ADF combatants.

Support to acquisition: S&T output and advice provided by the MSTC in the areas of signature management, power and energy and radiological science have enhanced the outcomes of acquisition projects including the Army's future Soldier Combat System.

Research and development: Research and advice on novel multi-functional materials have led to solutions for enhanced physical protection, power and energy harvesting, and signature reduction for dismounted combatants. Integrated soldier sensing, micro-autonomous systems and human-robot interaction in the battlefield and the development of standoff radiological imaging detection systems have also led to saving lives and enhanced mission effectiveness.



CBRN HAZARD ASSESSMENT

INTEGRATED PERSONNEL PROTECTION

ENABLING SYSTEMS AND CONCEPTS

S&T excellence

THREE YEAR PUBLICATION RECORD

- 2 Book chapters
- 28 Journal peer-review publications
- 25 Technical reports
- 31 Client reports
- 14 General discussion papers
- 13 Conference papers

PEER RECOGNITION

- 2 ARC Experts
- 1 PhD Examiner
- 3 International Associate Academics
- 3 Keynote Speaker Invitations

AWARDS

- Australia Day Medallion 2017
- 4 DST Achievement Awards
- 5 Divisional Awards for Excellence 2015
- 4 DMTC Capability Awards
- Fusion 2016, Best Paper Award, 2nd runner-up

Partnerships and outreach

UNIVERSITIES

- University of Melbourne
- RMIT
- University of NSW
- University of Adelaide
- Deakin University

INDUSTRY

- Bruck Textiles
- Wax Converter Textiles
- Bartlett Industrial Textiles
- ADA
- Tectonica
- A.C.E Body Armour

GOVERNMENT

- ANSTO
- Bureau of Meteorology
- CSIRO
- Geoscience Australia
- Victorian Department of Health

INTERNATIONAL

- CBR R&D Forum (AU/US/UK/CAN)
- DRDC (Canada)
- Dstl (UK)
- CERDEC, ARL (US)
- TTCP MAT and LND Groups
- NATO STO
- FSTD (Singapore)

S&T capabilities

CBRN HAZARD ASSESSMENT

The **CBRN Hazard Assessment** group leads the application of hazard assessment and modelling of CBRN threats and the provision of advice to assist with hazard detection, mitigation and consequence management.

INTEGRATED PERSONNEL PROTECTION

The **Integrated Personnel Protection** group leads the application of evidence-based integrated enabling research and experimentation for the protection of mounted and dismounted personnel.

SOLDIER AUTONOMY

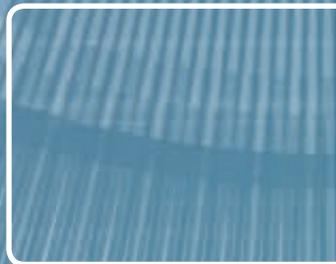
The multi-disciplinary **Soldier Autonomy** group undertakes innovative research and rapid-prototyping of novel developing technologies in augmented-reality; micro-robotics; sensors; energy-harvesting; and storage to enable the future integrated Soldier Combat System for dismounted combatant.

World-class capabilities and infrastructure



AEROSOL DEFENCE

Undertakes modelling and testing of aerosol dispersion and protection measures. Considered as world-class based on publications, facilities and international recognition.





Australian Government

Department of Defence
Science and Technology

Aerospace Division

Aerospace Systems Effectiveness

Goal

To support Defence outcomes in capability, efficiency and safety by providing advice and solutions where humans and air platforms or systems interact.

Impact

Training for the future battlespace: Developing tools, techniques and metrics which are transforming ADF aerospace collective training to enable 5th generation operations. Shaping future Live, Virtual and Constructive training through the RAAF Air Warfare Centre-Distributed Training Centre.

Human autonomy teaming: Researching fundamental techniques to ensure the ADF fully harnesses the capabilities of current and future autonomous systems.

Human performance: Providing advice on human cognition, human system interfaces and crewing concepts that impact the design and usage of ADF aerospace capabilities and the selection and training of aircrew.

Rotary wing systems effectiveness: Providing advice that enables reduced risk and increased capability for rotary wing platforms operating in challenging environments. S&T analysis provides critical information for rotary wing accident investigations such as the 2011 CH-47D accident in Afghanistan.



HUMAN FACTORS

AIR OPERATIONS
SIMULATION CENTRE



HELICOPTER SYSTEMS
EFFECTIVENESS

S&T excellence

THREE YEAR PUBLICATION RECORD

- 36 DST technical reports
- 14 DST client reports
- 10 Journal publications
- 41 Conference papers

PEER RECOGNITION

- 3 PhD supervisors
- 2 Defence Science Fellowships
- 1 TTCP Group National Representative
- 3 TTCP Panel National Leads
- 1 TTCP Panel Chair
- 6 Professional memberships
- 1 Editorial Board membership

AWARDS

- Simulation Australasia Achievement Award 2017
- DST Achievement Award 2017
- Best Paper Award Simulation Technology and Training 2013, 2014, 2015
- Royal Aeronautical Society Award 2015
- TTCP Award 2015
- DST Silver Award 2015
- Chief of Air Force commendation 2014
- Australia Day Medallion 2013

Partnerships and outreach

UNIVERSITIES

- University of Western Australia
- Western Sydney University
- RMIT
- Deakin University
- University of Queensland
- University of Sydney
- Swinburne University of Technology
- Queensland University of Technology

INDUSTRY

- AOS
- Boeing
- DefendTex
- Elmtex
- Simsol
- AVT
- Airbus Australia Group

GOVERNMENT

- Bureau of Meteorology
- Australian Defence Simulation and Training Centre

INTERNATIONAL

- TTCP AER and HUM Groups
- NATO STO HFM-247 Panel
- AFRL, Air Force Office of Scientific Research (US)
- ONRG, AMRDEC (US)
- University of Illinois Chicago (US)
- University of Liverpool (UK)
- DSO National Laboratories (Singapore)

S&T capabilities

HUMAN FACTORS

The **Human Factors** group conducts research into human-system effectiveness aspects within the aerospace domain.

AIR OPERATIONS SIMULATION

The **Air Operations Simulation** group specialises in simulation research and provides human-in-the-loop simulation and modelling capability to support ADF operations where aircrew are a critical component of the system or sub-system of interest.

HELICOPTER SYSTEMS EFFECTIVENESS

The **Helicopter Systems Effectiveness** group conducts research and develops models of physical aspects of military helicopters. It also conducts vision systems research with a focus on enhancing ADF capability in degraded visual environments, including night vision.

World-class capabilities and infrastructure



NIGHT VISION LABORATORY

This laboratory has a lighting system that is able to spectrally match moonlight conditions. The lab has the ability to conduct high precision measurements of optical parameters for night vision devices as well as night vision compatible lighting systems.



LIVE/VIRTUAL/CONSTRUCTIVE SIMULATION

Through the use of various simulation environments, including the Air Operations Simulation Centre and the Air Warfare Centre-Distributed Training Centre, this capability is progressing Defence's understanding regarding the correct blend of Live, Virtual and Constructive elements required to deliver an optimal training capability.

Aircraft Health and Sustainment

Goal

Enable safe, supportable and affordable operation of ADF air vehicle fleets over their life-cycle through a focus on asset and health management technologies.

Impact

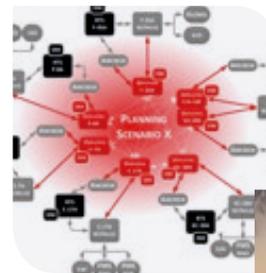
Safety: Provision of an effective aircraft system health management capability that enhances airworthiness through projects such as the: PC9 engine filter debris screening; provision of expert capability during accident/incident investigations; Landing Helicopter Dock Pod Bearing; and Growler.

Support to operations: Contributing to enhanced covert mission planning and survivability by measuring aircraft aural signatures.

Future force experimentation: Delivery of enabling support to Air Force war gaming including Plan Jericho Theme 11 and the development of non-intrusive flight testing instrumentation for on-demand flight trials.

Platform acquisition: Ongoing S&T support of Defence acquisition decision making including those related to AIR 7000 (fleet size determination); AIR 9000 (Health and Usage Monitoring System (HUMS) technologies); and AIR 6000 (propulsion system, vibration diagnostics and wear debris analysis).

Strategic research: Autonomous material state awareness systems for enhanced availability; development of innovative infrared signature coatings for improved survivability; advanced high temperature materials and fuels for high speed flight.



AEROSPACE SYSTEMS
SUSTAINMENT
ANALYSIS

VEHICLE DYNAMICS
AND DIAGNOSTICS



ENGINES AND
FUELS INTEGRITY

AIRFRAME
DIAGNOSTIC
SYSTEMS



S&T excellence

THREE YEAR PUBLICATION RECORD

- 54 DST reports
- 39 Journal publications
- 46 Conference papers
- 2 Book chapters
- 6 Patents

PEER RECOGNITION

- 3 CDS Fellowships
- 2 ARC Reviewers
- 1 CSIRO Endowment Fund Reviewer
- 1 Prestige Marie Curie Reviewer (FR)
- 1 Marsden Fund Reviewer (NZ)
- 4 PhD supervisors
- 3 Journal Associate Editors and Internal Scientific Boards
- 2 TTCP National Leads
- 1 External Course Advisory Committee
- 3 Conference Chairpersons

AWARDS

- US Office of Secretary of Defense Medal for Exceptional Public Service 2014
- Royal Aeronautical Society Aviation Safety Award 2016
- TTCP Achievement Award 2013
- Combined Joint Task Force 633 Silver Commendation 2013
- Level 3 Commendation Dep Sec CASG 2017
- DST Bronze Commendation 2016
- Australia Day Medallion 2016
- 9 DST Awards since 2010
- DST Solvelt award 2015
- Best Conference Paper 2015

Partnerships and outreach

UNIVERSITIES

- Monash University
- RMIT
- Melbourne University
- Swinburne University
- Deakin University
- Adelaide University
- Sydney University
- Wollongong University

INDUSTRY

- Defence Innovations
- Northrop Grumman
- Van Gelder and Monk
- Honeywell
- LRM Technologies
- Lockheed Martin

GOVERNMENT

- Bureau of Meteorology
- Australian Synchrotron
- ASC

INTERNATIONAL

- TTCP AER and MAT Groups
- F-35 Joint Program Office (US)
- ABCANZ
- University of South Carolina (US)
- ONR Global
- Laval University (Canada)
- Georgia Tech (US)

S&T capabilities

VEHICLE DYNAMICS DIAGNOSTICS

The **Vehicle Dynamics and Diagnostics** group assesses and develops health state awareness technologies for aircraft propulsion systems; evaluates aircraft aural signatures; and assesses health management systems for improved sustainment of aerospace platforms.

ENGINES AND FUEL INTEGRITY

The **Engines and Fuel Integrity** group assesses and validates propulsion structural integrity, including lifing, durability and reliability, as it impacts on availability and airworthiness; and develops advanced high temperature materials and fuels for high speed flight.

AIRFRAME DIAGNOSTIC SYSTEMS

The **Airframe Diagnostic Systems** group provides assessment, development, prototyping and operational evaluation of advanced structural diagnostic and material state awareness technologies for through-life support and improved availability of airframes.

AEROSPACE SYSTEMS SUSTAINMENT ANALYSIS

The **Aerospace Systems Sustainment Analysis** group undertakes detailed systems analysis of aerospace platforms to facilitate improved acquisition and sustainment decision-making over the capability life cycle.

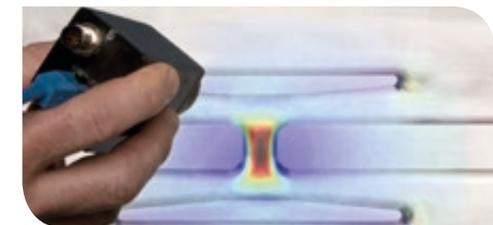
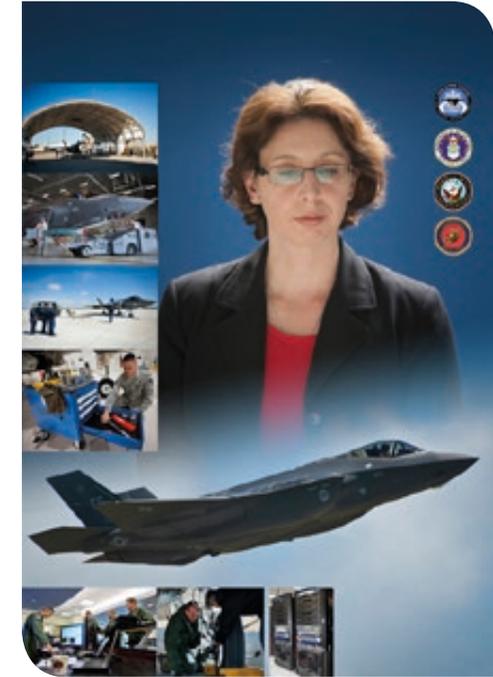
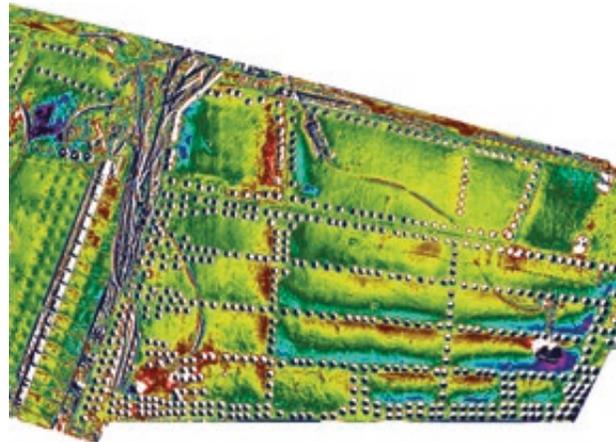
World-class capabilities and infrastructure

AIRCRAFT HEALTH MANAGEMENT SYSTEMS

World-class expertise in aircraft health management systems (Health and Usage Monitoring System) and Prognosis and Health Management), including propulsion system vibration monitoring and wear debris analysis. Recognised by the US Department of Defense medal for JSF PHM.

MITE

MiTE thermoelastic stress analysis is a groundbreaking full-field stress visualisation technology developed by DST and is used internationally as an R&D capability by academia and industry in support of programs including full-scale structural fatigue testing of legacy and 5th generation airframes (e.g. F/A-18 and F-35).



Aircraft Performance and Survivability

Goal

To enable a military advantage through S&T capabilities that ensure aircraft survivability, decision superiority, flexible strike and trusted autonomy in the Air Domain.

Impact

Operations: Enhanced survivability of military aircraft through signature reduction technologies and validated Airborne Electronic Warfare Self-Protection systems. Validated safe carriage of weapons for deployed aircraft through vibration assessment advice. Enhanced force protection through characterisation of, and counter technologies for, unmanned and manned aerial threats.

Sustainment: Enhanced capability of the JDAM weapon by range extension (JDAM-ER) through aerodynamic design, development, test and evaluation.

Platform acquisition: Reduced acquisition risk of the F-35A through weapons integration research via an AUS/US Partnership under Project AIR 6000.

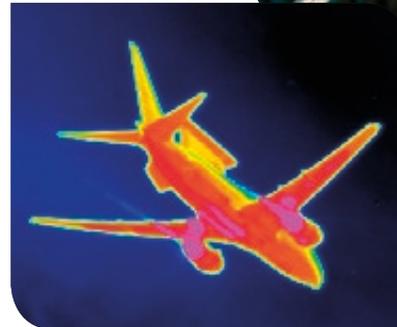
Future proofing: Demonstrated closed-loop, vision aided, alternate navigation for autonomous unmanned air vehicle operations in GPS-denied environments. Demonstrated machine reasoning techniques to enable human-on-the-loop multi-robotic teaming.



AERIAL AUTONOMOUS SYSTEMS



AERODYNAMICS AND AEROELASTICITY



INFRA-RED SIGNATURES AND AEROTHERMODYNAMICS

S&T excellence

THREE YEAR PUBLICATION RECORD

- 63 DST technical reports
- 45 DST client reports
- 21 Journal publications
- 101 Conference papers
- 3 Chapters in NATO Report

PEER RECOGNITION

- 1 University Advisory Committee
- 4 PhD Supervisors
- 1 NATO STO AVT Technical Panel Chair
- 2 TTCP AER Group National Leads
- Chair of the Supersonic Tunnel Association International (STAI)
- AIAA Membership

AWARDS

- 2 Prime Ministers Awards for excellence in Public Sector Management 2013
- AFP Commendation for MH17 support 2015
- RAAF (DGSP) Commendation 2013
- 1 NATO STO SET Panel Achievement Award 2014
- Aerospace Group TTCP Award 2017
- DST Bronze Commendation 2015
- 2 Best Papers at 16th Australian International Aerospace Conference 2015

Partnerships and outreach

UNIVERSITIES

- Sydney University
- RMIT
- Deakin University
- University of NSW
- Defence Science Institute
- Monash University
- University of South Australia
- Melbourne University
- University Queensland
- Australian National University

INDUSTRY

- Boeing (US)
- AVTOL
- ASE, DMTC
- CAE Pty Ltd
- Hardchrome
- QinetiQ
- Grollo Aerospace
- Lockheed Martin

GOVERNMENT

- Australian Federal Police
- Bureau of Meteorology

INTERNATIONAL

- ATLA (Japan)
- DSTA (Singapore)
- TTCP AER Group
- NATO STO AER Panel
- Arnold Engineering Development Complex (US)
- Cranfield University (UK)
- USAF Seek Eagle Office (US AFSEO)
- Dstl (UK)
- DLR (Germany)
- Sandia Labs, NASA, USN, USAF AFRL (US)
- RCAF (Canada)

S&T capabilities

AERIAL AUTONOMOUS SYSTEMS

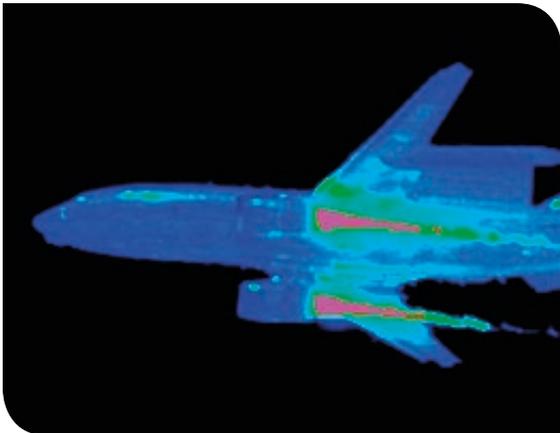
The **Aerial Autonomous Systems** group undertakes research on the application and integration of autonomy into unmanned aerial systems (UAS) operating in a military environment.

AERODYNAMICS AND AERO-ELASTICITY

The **Aerodynamics and Aero-elasticity** group conducts research into steady and unsteady fluid dynamics in flow regimes ranging from incompressible, subsonic, transonic, supersonic and hypersonic and the impact that this airflow has on the flight performance of military aircraft.

INFRARED SIGNATURES AND AEROTHERMODYNAMICS

The **Infrared Signatures and Aerothermodynamics** group conducts research into the measurement, modelling and control of infrared signatures for aircraft survivability.



World-class capabilities and infrastructure



AIRCRAFT PERFORMANCE MODELLING AND SIMULATION

The Aircraft Performance Modelling and Simulation area provides world-class assessments of the characteristics and performance of military aircraft. The excellence of the capability is acknowledged by International partners.



AIRCRAFT INFRARED SIGNATURE MEASUREMENT, MODELLING AND MANAGEMENT

The Aircraft IR Signature area provides world-class infrared signature assessments of, and treatments for, Australian military aircraft to ensure their survivability. The excellence of the capability is acknowledged by our NATO partners and is evidenced by recognition from clients.

Aircraft Structures

Goal

To provide safety-critical aircraft structural integrity and airworthiness advice and solutions to the ADF through targeted partnerships, research and application of innovative science and technology.

Impact

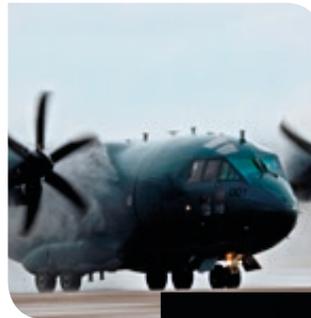
Safety: The provision of critical test results and analyses as the evidence base required for airworthiness qualification under Australian configuration, role and environment for aircraft such as the BAE Systems Hawk LIF, C-130J and C-27J.

Costs: Advanced testing and analysis has provided Defence with significant cost avoidance or life extensions for aircraft such as the F/A-18 Hornet (\$400M saved) and AP-3C (\$388M saved).

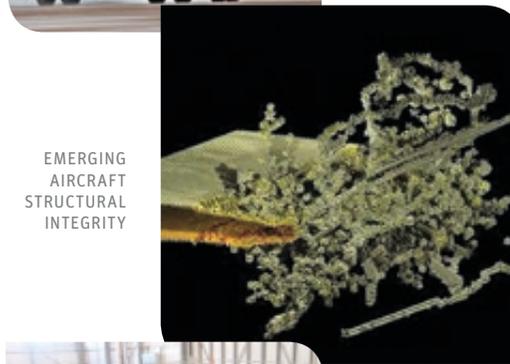
Capability: Ensuring full capability through maximising availability and readiness of air assets, eg, F/A-18 Hornet, PC-9 and AP-3C. Contributing to a sovereign industry capability for aircraft sustainment via industry alliances, e.g. QinetiQ.

Acquisition: Contributing to ADF's smart-buyer status through rigorous technical risk assessments. Our science has influenced development programs that will lead to significant long term future benefits, e.g. F-35 structural durability.

Future: World-leading science has contributed to the advancement of aircraft structural integrity testing and analysis resulting in enhanced capability for ADF aircraft.



AIRWORTHINESS
AND LIFE
EVALUATION



EMERGING
AIRCRAFT
STRUCTURAL
INTEGRITY



STRUCTURAL
EXPERIMENTATION

S&T excellence

THREE YEAR PUBLICATION RECORD

- 35 DST technical reports
- 23 DST client reports, technical assessments and Defence papers
- 23 Journal publications
- 45 Conference papers
- 2 Book chapters

PEER RECOGNITION

- ARC Expert College member
- 2 PhD examiners
- Editorial Board member
- TTCP AER Group National Lead
- National Delegate – International Committee on Aeronautical Fatigue and Structural Integrity

AWARDS

- US Secretary of Defence Medal for Exceptional Public Service 2017
- Australian Operational Service Medal – Civilian 2013, 2017
- Order of Australia AM 2016
- Best Paper in J. Expt Mech 2016
- Public Service Medal 2015
- TTCP AER Group Award 2014
- Client Commendations: Deputy Chief of Airforce 2014, PM NACC 2013
- Outstanding Contribution to reviewing – International journal of Fatigue February 2017

Partnerships and outreach

UNIVERSITIES

- RMIT
- Monash University
- University of NSW Canberra
- Swinburne University
- Melbourne University

INDUSTRY

- QinetiQ
- Boeing
- BAE Systems
- AGAP
- RUAG
- Northrop Grumman
- Lockheed Martin

GOVERNMENT

- CASA

INTERNATIONAL

- TTCP AER Group
- NATO STO
- Royal Air Force, Dstl (UK)
- RCAF, NRC, Bombardier (Canada)
- NAVAIR, USAF AFRL, LMLC (US)
- Royal New Zealand Air Force, DTA (NZ)
- Armasuisse (Switzerland)
- Finnish Air Force

S&T capabilities

AIRWORTHINESS AND LIFE EVALUATION

The **Airworthiness and Life Evaluation** group integrates knowledge of airworthiness standards and the capability to conduct research and innovation into the evaluation of structural life in order to provide airworthiness advice and solutions to the ADF's current, acquired and future force under Australia's unique operating conditions.

EMERGING AIRCRAFT STRUCTURAL INTEGRITY

The **Emerging Aircraft Structural Integrity** group conceives, develops and champions emerging methodologies in determining and/or predicting aircraft strength and durability, ensuring aircraft structural integrity under prescribed operational conditions.

STRUCTURAL EXPERIMENTATION

The **Structural Experimentation** group provides structural test capabilities that span a broad spectrum of structural and material requirements, covering small coupon tests for material characterisation up to full scale tests of entire airframes for the purpose of determining their static strength and durability.

World-class capabilities and infrastructure

QUANTITATIVE FRACTOGRAPHY

The MSTC conducts world-leading research and capability in the development and use of quantitative fractography for the determination of crack growth life in aircraft metallic structures under both test and in-service loading sequences.

SHORT-CRACK THRESHOLD MODELLING

World-class research into the behaviour of very small cracks in metallic structures has led to a number of unique techniques for the measurement of crack growth rates and behaviours.

THERMOELASTIC STRESS ANALYSIS

Applying DST's world-leading developments in the technique of thermal stress analysis to a range of full-scale fatigue tests has led to reduced cost and risks associated with structural certification programs.

FULL SCALE FATIGUE TESTING

The MSTC's ability to combine its full scale testing capability with skills in test development and control, aircraft loads measurement, stress and structural analysis, aircraft usage analysis, and strength and durability assessment is on par with major aircraft manufacturers and provides the ADF with a sovereign capability not matched within the region.



Airframe Technology and Safety

Goal

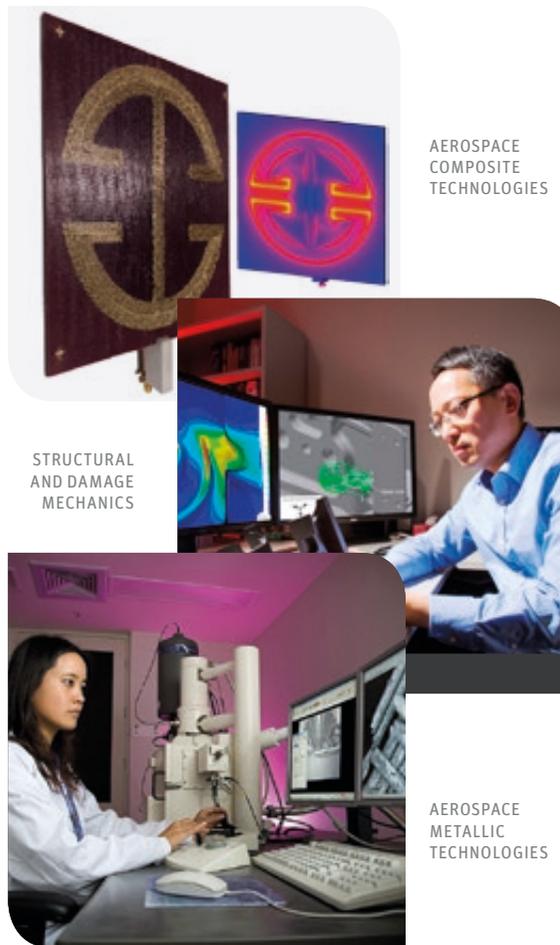
To maximise aircraft capability and safety through the development and application of leading edge computational modelling and materials systems research.

Impact

Operational capability: The operational capability of the F/A-18 fleet was restored in time for their deployment to Operation OKRA. This was achieved through the application of advanced metallographic assessment, computational modelling and biologically inspired shape optimisation of the SUU-62 centreline pylon.

Acquisition and safety: The safety of flight of the JSF fleet has been increased through the appropriate lifing of anodised components undertaken due to ATS MSTC research into the effect of the anodising process on fatigue initiation.

Operational availability: A model developed to predict the airworthiness impact of intergranular corrosion on the RAAF AP-3C Orion aircraft has led to an estimated \$30M reduction in maintenance costs and has increased aircraft availability.



S&T excellence

THREE YEAR PUBLICATION RECORD

- 39 DST technical reports
- 157 DST client reports
- 54 Journal publications
- 68 Conference papers
- 7 Book chapters

PEER RECOGNITION

- 5 PhD supervisors
- 4 PhD examiners
- 23 Journal reviews
- 1 International Journal Editorial Board
- ESDU Committee Panel member
- 1 CDS Fellowship
- 3 Adjunct Senior Research Fellows
- TTCP MAT Group Panel Chair for TP12 & Panel Chair for TP13
- TTCP AER Group Panel Chair

AWARDS

- Jaap Schijve Award for young aeronautical engineers 2013
- TTCP AER Group Award 2014
- DST Achievement Awards for; Technical Excellence 2016, Outstanding Early Career Achievement 2014
- Best Paper International Workshop on Antenna Technology 2016
- Best presentation at 2017 International Conference on Fracture Mechanics, Polymers, Composites and Adhesives
- BAE Systems Chairman's Award for Innovation 2018

Partnerships and outreach

UNIVERSITIES

- Swinburne University
- University of Queensland
- Melbourne University
- Macquarie University
- La Trobe University
- Deakin University
- Australian Synchrotron
- Monash University

- University of Sydney
- RMIT

INDUSTRY

- Qinetiq
- RUAG Australia
- BAE Systems Australia
- Airbus Group Asia Pacific

- Boeing Defence Australia
- DMTC
- Altair

GOVERNMENT

- ANSTO
- AFP
- ATSB

- CASA
- CSIRO

INTERNATIONAL

- National Research Council (Canada)
- University of Delaware (US)
- Norwegian Technology University

- Fraunhofer ILT (Germany)
- Dstl (UK)
- Renishaw Corp (UK)
- Texas University (US)
- Mississippi State University (US)
- AFRL; FractureLab (US)
- Lawrence Livermore National Laboratory (US)

- International Accident Agencies: AAIB, NTSB, BEA
- TTCP AER and MAT Groups
- NAVAIR, Naval Air Warfare Center (US)
- IMP Group International Inc. (Canada)
- University of Calif, Davis (US)

S&T capabilities

AEROSPACE METALLIC TECHNOLOGIES

The **Aerospace Metallic Technologies** group provides expert S&T advice and innovative solutions to Defence and national security agencies through the development of multifunctional metallic materials and technologies, and high impact forensic science.

AEROSPACE COMPOSITE TECHNOLOGIES

The **Aerospace Composite Technologies** group provides Defence with leading edge capabilities through the development of multifunctional composite materials and innovative sustainment solutions for advanced composite structures.

STRUCTURAL AND MATERIAL MECHANICS

The **Structural and Material Mechanics** group provides expert S&T advice and innovative solutions to Defence through the development and application of innovative computational structural and multi-disciplinary material modelling.

World-class capabilities and infrastructure



ADVANCED COMPOSITE TECHNOLOGIES

Research of advanced multifunctional materials is internationally recognised as a world-leading capability, as evidenced by high quality journal publications, citations, awards, reputation of science leaders, partnerships with leading universities and the translation of research into Defence outcomes.

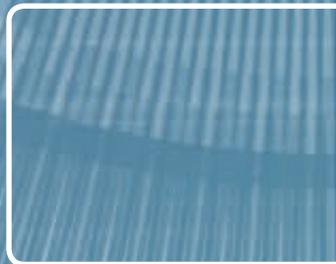


SHAPE AND RE-WORK OPTIMISATION

With high quality publications, reputation of key science leaders, awards, and significant translation of science to Defence outcomes, shape optimisation research is a world leader.

FORENSIC CAPABILITY

The forensics team is acknowledged by clients as a world-class capability in providing exemplary outputs that are critical to ongoing safe aircraft operation and improved aircraft availability.





Australian Government

Department of Defence
Science and Technology

Joint and Operations Analysis Division

Aerospace Capability Analysis

Goal

To enhance ADF aerospace capability by providing expert impartial scientific advice informing acquisition decisions, supporting operations, and future-proofing Defence capability.

Impact

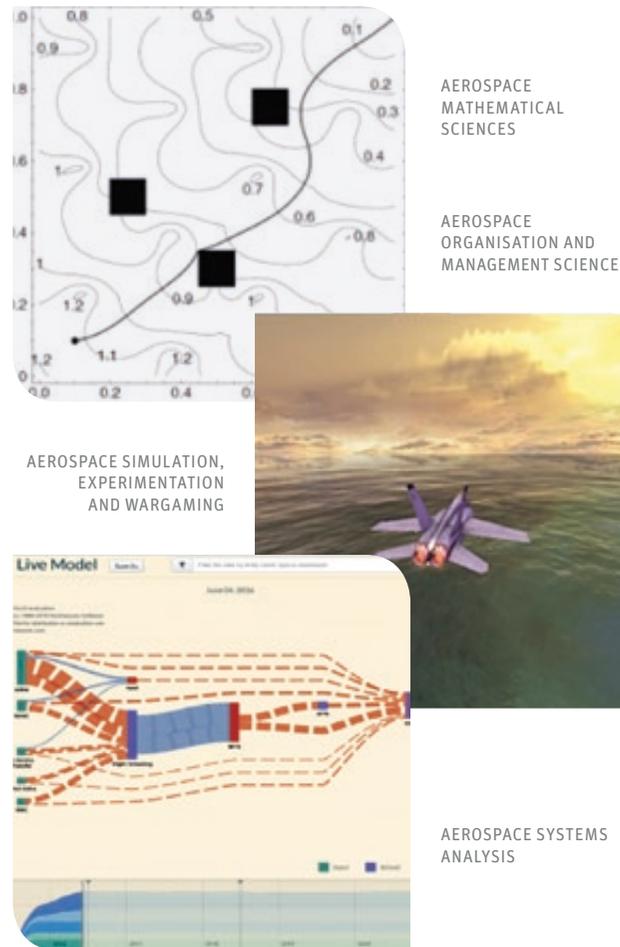
Aerospace Project Support: With a focus on integration into the wider force, informing CONOPS/tactics development and informing upgrade decisions, ACA has supported acquisition and introduction into service of aerospace platforms such as the F-35A, EA-18G, P-8A and MH-60R.

Air Force Experimentation: Provision of ongoing support has enabled Air Force to make strategic decisions about its future roles in delivering joint operational effects through examining new concepts of operation and capabilities against the planned force structure.

Plan Jericho: ACA has enabled Plan Jericho by providing S&T research and advice on broader capability options, understanding of emerging threats, and development of innovative applications of new technology for an edge in warfighting.

Air Warfare Centre: ACA has enabled Air Force to develop integrated air warfighting tactics (e.g. USAF Red Flag, RAAF Pitch Black) by providing and developing an ongoing Operations Analysis capability.

Training Analysis: ACA has provided tools to ADF aircrew training establishments for optimising training pipelines, with the aim of improving efficiency in the continuum and providing decision making support.



S&T excellence

THREE YEAR PUBLICATION RECORD

- 16 DST technical reports
- 30 DST client reports
- 20 Journal publications
- 60 Conference papers

PEER RECOGNITION

- Chair TTCP AER TP-11 Challenging and Future Operations
- ARC Partner Investigator
- Senior Research Fellows, Uni of Melbourne
- Fellow, The Institution of Engineers Australia
- Editorial Board J. App. Ergonomics and J. Cognitive Eng and Decision Making
- Journal reviewers: IEEE, Defence Technology and Electronics Letters

AWARDS

- Air Warfare Centre Commander's Commendation
- TTCP team award 2017
- AFP Commissioner's Certificate 2016 for MH17 investigation support
- DST Silver 2016 and Bronze 2016 Commendations for Rotary Wing work program
- Defence Operations Research Symposium best paper awards 2014, 2015

Partnerships and outreach

UNIVERSITIES

- RMIT
- University of Melbourne
- University of South Australia
- Deakin University
- Edith Cowan University
- Federation University

INDUSTRY

- Boeing
- Lockheed Martin
- SAAB Australia

INTERNATIONAL

- TTCP AER Group
- Dstl (UK)
- UK Air Warfare Centre
- USAF HQ A9 (US)
- AFRL (US)
- NAVAIR (US)
- Naval Postgraduate School (US)
- Glasgow University (UK)

S&T capabilities

AEROSPACE MATHEMATICAL SCIENCES

The **Aerospace Mathematical Sciences** group develops and applies mathematical models of aerospace systems and operations to quantify effectiveness and to explore sensitivities to system performance.

AEROSPACE ORGANISATIONAL AND MANAGEMENT SCIENCE

The **Aerospace Organisational and Management Science** group addresses complex air power issues with broad organisational impact and significant uncertainty. The group is recognised for the research, development and application of a broad range of techniques to address aerospace power challenges.

AEROSPACE SIMULATION, EXPERIMENTATION AND WARGAMING

The **Aerospace Simulation, Experimentation and Wargaming** group develops and applies human-in-the loop and constructive computational tools to address challenging operations research problems to enhance aerospace power.

AEROSPACE SYSTEMS ANALYSIS

The **Aerospace Systems Analysis** group conducts studies to improve the effectiveness of individual aerospace system capabilities as well as their integration across the ADF.

World-class capabilities and infrastructure



COGNITIVE WORK ANALYSIS

Research that has shaped understanding of the cognitive complexity faced by humans in work environments characterised by change and ambiguity. The capability has developed a model for representing this complexity that is compatible with 'real-world' systems.



TRAINING ANALYSIS

Research that is developing new and innovative planning, optimisation and prediction tools delivering affordable, effective and sustainable training continuum solutions for Defence.

AGENT-BASED TEAM TACTICS IN ACE

Best practice capability developing and applying agent based technologies to the evolution of team air combat tactics in simulation tools such as the MSTC's Air Combat Environment.

Land Capability Analysis

Goal

To provide evidence and analysis to support decisions on land force structure and capabilities, focussing on operational effectiveness through applying and developing operations research methods, tools and techniques.

Impact

Close combat: By evaluating contributions made by elements of the Combined Arms Teams to close combat effectiveness the LCA MSTC has ensured Army has the required mix of capabilities to succeed at close combat into the future.

Ground combat enablers: Assessment and advice of the impact of various land combat enablers (including situational understanding; command, control and communications; and combat support) and joint enablers by LCA, support has contributed to improved operational effectiveness of the reinforced combat brigade engaged in joint land manoeuvre.

Shape future Army: Army has been supported in the design and development of a robust and adaptive force for joint interagency land operations by providing whole-of-force evidence.

Analytical wargaming: Developing a wargaming capability fosters the application of wargaming analytical models and techniques for joint and land force design.



LAND SIMULATION,
EXPERIMENTATION
AND WARGAMING

LAND MATHEMATICAL
SCIENCES



LAND ORGANISATIONAL
AND MANAGEMENT
SCIENCES

S&T excellence

THREE YEAR PUBLICATION RECORD

- 18 DST technical reports
- 47 DST client reports
- 15 Journal publications
- 40 Conference papers
- 1 Book chapter

PEER RECOGNITION

- TTCP LND Group National Lead for TP1 Soldier Combat Systems
- Lead, Modelling Complex Warfighting SRI
- Military Operations Research Society, Board representative for Australia
- Australian Society for Operations Research (ASOR)
- Australasian Bayesian Network Society

AWARDS

- Rist Prize (MORS 2017)
- Morry Frost Operations Research 2014
- Australia Day Award 2014
- DST Bronze Commendation 2013
- 85th Barchi Prize Nomination

Partnerships and outreach

UNIVERSITIES

- University of South Australia
- Deakin University
- Monash University
- University of NSW Canberra
- Curtin University
- Flinders University

INDUSTRY

- Synthetikos
- Averill M. Law & Associates, Inc.
- RAND Corporation
- Ytek
- Consilium

INTERNATIONAL

- TTCP LND Group
- Naval Postgraduate School
- US Army Training and Doctrine Command Analysis Center (TRAC)
- US Center of Army Analysis (CAA)
- Dstl (UK)
- Cranfield University (UK)

S&T capabilities

LAND MATHEMATICAL SCIENCES

The **Land Mathematical Sciences** group develops and applies mathematical operations research methods and models for the assessment of land force capability.

LAND ORGANISATION AND MANAGEMENT SCIENCE

The **Land Organisation and Management Science** group is recognised for the development and application of qualitative methods and models to support the development of land force concepts.

LAND SIMULATION, EXPERIMENTATION AND WARGAMING

The **Land Simulation, Experimentation and Wargaming** group is responsible for the design, conduct and analysis of live, virtual and constructive simulation-based experimentation that supports the land force.

World-class capabilities and infrastructure



WARGAMING

Wargaming and Adaptive Red Teaming capabilities provide quick and contestable decision support that enhance the understanding of tradeoffs in joint land force effectiveness. This capability exploits human-centric adversarial approaches and has strong internal and external collaboration.

Maritime Capability Analysis

Goal

To support evidence-based decisions on Navy's Force structure, concepts, acquisition of systems, operational effectiveness and capability management.

Impact

Future force: Conducting experimentation and analysis for Navy Strategic Command to support future warfighting concepts and force design. Established the needs case for Future Frigate.

Acquisition projects: Combining operational knowledge with performance modelling to provide evidence informing decisions on requirements and options for maritime projects including Future Submarine and Future Frigate.

Current fleet operations: Conducted research to support Fleet Command in transitioning from single-ship to Task Group level operations. Assessing the effectiveness of the surface and subsurface fleet informs major projects and Navy's Maritime Warfare Program.

Fleet data: The Navy's assessment of operational performance, fleet optimisation, gap identification and exercise analysis has been enhanced through the development of a big data repository and an agile and comprehensive data analytics capability.



MARITIME
MATHEMATICAL
SCIENCE



MARITIME SIMULATION
EXPERIMENTATION AND
WARGAMING



MARITIME
SYSTEMS
ANALYSIS

S&T excellence

THREE YEAR PUBLICATION RECORD

- 10 DST technical reports
- 26 DST client reports
- 15 Journal publications
- 21 Conference papers

PEER RECOGNITION

- Industry Board Membership – Monash
- 1 ARC Assessor
- Journal reviewers for; Ergonomics, SysEng, Ethics and IT
- Australian Society for Operations Research National Conference secretary
- Professional memberships of AustMS, IEEE, MORS, MSSANZ

AWARDS

- Project SEA 5000 Bronze Commendation 2017
- TTCP award 2014
- RAN Fleet Commander Bronze Commendation 2015
- DST Achievement Award for Outstanding Communication of S&T 2015, 2016
- Best Papers Defence Operations Research Symposium 2014, 2016
- CEID SolveIT challenge 2015 winner

Partnerships and outreach

UNIVERSITIES

- Australian National University
- Macquarie University
- University of NSW
- RMIT
- University of Adelaide

INDUSTRY

- RAND Corporation
- Defence Science Institute

INTERNATIONAL

- TTCP MAR Group
- Maritime Warfare Centre (UK)
- UK, NZ and Netherlands Navies
- US Navy/US Marine Corps
- Indian Navy
- Pakistan Navy
- University of Bristol (UK)
- University of Cambridge (UK)
- UK Royal Society

S&T capabilities

MARITIME MATHEMATICAL SCIENCES

The Maritime Mathematical Sciences group provides mathematical modelling of maritime systems and operations in order to quantify effectiveness and to explore its sensitivity to system performance and assumptions.

MARITIME SIMULATION, EXPERIMENTATION AND WARGAMING

The Maritime Simulation, Experimentation and Wargaming group provides design, facilitation, support and analysis for the purpose of analysing maritime force concepts, eliciting expert judgement and measuring current capabilities.

MARITIME SYSTEMS ANALYSIS

The Maritime Systems Analysis group provides definition, representation and modelling of enterprise and capability systems from a whole-of-system perspective, applied to complex maritime capabilities such as the amphibious capability and submarines.

World-class capabilities and infrastructure



CONCEPT EXPLORATION AND ANALYSIS FACILITY

The CEAL facility has been designed specifically for wargaming and experimentation and meets best practice for such use. In addition data analytics capabilities are suitably supported by dedicated servers.

Joint Warfare and Operations

Goal

To enhance and support planning and preparation for, and employment of, the integrated joint force in current and future operations, and enable ADF to achieve a capability edge in decision making at the strategic and operational level.

Impact

Support to operations: Enhanced mission effectiveness and reduced operational risk to the deployed force has resulted from the coordinated DST support to operations program. Research into improved methods to understand the human and cultural environment has provided key inputs into operational planning and conduct.

Directorate of strategic fuels: Advice on logistics estimate of surge requirements and supply options for marine and aviation fuels informing defence storage and supply contracts.

Commander: Decision instrument used by Australian Defence College to improve joint professional military education.

Situation awareness tools: Development of tools to enhance situation awareness in operations and exercises which were used by HQJOC in Op Fiji Assist.

Fifth generation HQ conceptualisation: Informing the development of next generation HQ structures and functions.



COMMAND INTENT



SITUATION ASSESSMENT



PLANNING AND LOGISTICS

BEHAVIOUR AND CONTROL

S&T excellence

THREE YEAR PUBLICATION RECORD

- 28 DST technical reports
- 18 DST client reports
- 45 Journal publications
- 49 Conference papers
- 1 Book

PEER RECOGNITION

- 2 Academic Board Memberships
- 2 Academic Fellows
- Honorary Senior Research Fellow Oxford University
- Vice President Australian Society for Operations Research
- 1 Adjunct Professor (UniSA)
- 1 CDS fellowship
- 1 Principal Scientist

AWARDS

- Defence Fellowship 2013–2016
- Secretary of Defence Fellowship 2014, 2015
- ADF Journal Best Paper 2015
- CDS Gold Commendation 2016
- Alphonse Chapanis Best Student Paper Award 2016

Partnerships and outreach

UNIVERSITIES

- University of South Australia
- Melbourne University
- Australian National University
- University of Adelaide
- Flinders University
- University of NSW Canberra
- Deakin University
- University of Wollongong

INDUSTRY

- Consunet Pty Ltd.
- Elmtek Pty Ltd.
- KIAH Consulting
- Data to Decisions CRC/TAS-SRI

GOVERNMENT

- Bureau of Meteorology
- Australian Federal Police
- Department of Foreign Affairs and Trade
- Australian Civil Military Centre

INTERNATIONAL

- TTCP Autonomous Strategic Challenge
- SPAWAR (US)
- University of Southampton (UK)
- CTTSO (US)
- Dstl (UK)
- University of Oxford (UK)
- Kings College London (UK)
- Stabilisation Unit (UK)

S&T capabilities

PLANNING AND LOGISTICS

The **Planning and Logistics** group develops theories of planning for application to decision systems, automated decision aids, automated decision makers, and cooperative human-machine planning integration in command, control and logistics.

SITUATION ASSESSMENT

The **Situation Assessment** group develops new methods for agile and automated situation assessment and planning, and technologies for collaborative human-machine teaming in the command and control of operations.

JOINT ORGANISATION AND SOCIAL SCIENCE

The **Joint Organisation and Social Science** group develops and applies qualitative operations research techniques and organisational and social science analysis techniques to evolve joint capabilities and to promote organisational learning.

COMMAND INTENT

The **Command Intent** group is involved in the scientific study of intent and coordinated intentional actions, focussing on human individual processes and their differences.

BEHAVIOUR AND CONTROL

The **Behaviour and Control** group is involved in the scientific study of control actions, focussed on human and machine collective processes and their similarities.

World-class capabilities and infrastructure



HQ JOINT OPERATIONS COMMAND OA

The Joint Operations Command S&T team plays a key role in providing evidence based operations analysis in support of joint operational planning. Together with the Joint Organisational and Social Science team, operations analysis has been applied to support the full spectrum of ADF operations.

VITAL PLANNING AND ANALYSIS (VIPA)

VIPA is a strategic operations joint logistics planning and feasibility tool developed by DST. VIPA is used by various ADF Headquarters and has been deployed in operations. It is sustained as a component of the Joint Command Support Environment.

SITUATIONAL AWARENESS KNOWLEDGE INFRASTRUCTURE (SAKI)

The SAKI prototype supports current operations by providing joint commanders with shared situational awareness and planning capabilities. SAKI integrates information across the Defence enterprise fusing information from multiple sources enabling decision superiority.

Strategy and Joint Force

Goal

To influence strategic thinking in Defence and national security; inform decisions for future capability; and shape capabilities to be joint and integrated-by-design to maximise Defence effectiveness.

Impact

Technology foresighting: Impact of future environments and emerging technologies through Emerging and Disruptive Technology Assessment Symposia and the Strategic S&T Outlook.

Force design: Analytical support to the ADF HQ Force Design Division has enabled delivery of an integrated Joint Force by Design that is capable, potent and agile in achieving strategic Defence objectives.

Strategic analysis: Enhanced robustness and resilience of Defence and national security policy has been enabled through analytical support and advice regarding: strategy and plans to uncertainties in the future environment; strategic centre preparedness; contestability; enterprise management; force design and strategic planning functions.

Force integration: Influence the development within the Australian Defence Organisation of system-of-systems engineering to achieve integration-by-design.

Joint concepts experimentation: Testing and evaluation of concepts that allow the ADF to be better prepared and have an enhanced understanding of complexities in joint operations.



DEFENCE
SYSTEMS
INTEGRATION

TECHNOLOGY
FORECASTING
AND FUTURES

FORCE DESIGN

JOINT WARFARE
MATHEMATICAL
SCIENCES



STRATEGIC
ANALYSIS

JOINT SIMULATION
EXPERIMENTATION
AND WARGAMING

S&T excellence

THREE YEAR PUBLICATION RECORD

- 51 DST technical reports
- 34 DST client reports
- 27 Journal publications
- 98 Conference papers
- 2 Book editor

PEER RECOGNITION

- ANU Honorary Associate Professor
- ARC Grant Assessor
- Australian Defence Force Academy Defence Grants Board
- Secretary of Defence Fellowship 2012, 2014
- CDS Fellowship 2016
- Defence International Fellowship 2015
- ADF Journal Editorial Board
- TTCP HSSDI Panel Chair
- Fellow of Dr. Schöller Research Center for Business and Society, Germany
- Honorary Fellow of Charles Darwin University's Northern Institute
- Members of: Australian Society of Operations Research, Institute for Regional Security, IEEE
- Editor Springer Advances in Military Geosciences

AWARDS

- Defence Gold Awards 2014, 2016
- Australian Operational Service Medal 2015, 2016
- Best Paper InSITE 2014
- TTCP award (Systems-of-Systems Engineering) 2015
- Morry Frost Award 2016 for outstanding contribution to Australian Defence OR
- DST Achievement Award Finalist 2017
- Gus Schaefer Award for best paper DORS 2017

Partnerships and outreach

UNIVERSITIES

- Australian Academy of Science
- Australian National University
- National Security College
- Flinders University
- University of NSW
- Charles Darwin University

INDUSTRY

- Noetic
- Australian Strategic Policy Institute

GOVERNMENT

- Australian Federal Police
- Attorney General's Department

INTERNATIONAL

- TTCP Horizon Scanning and Technology Foresight for Strategic Defence Innovation Technical Panel
- Dstl (UK)
- DRDC (Canada)
- Hague Centre for Strategic Studies (Netherlands)
- NATO SAS-124 RTG

S&T capabilities

DEFENCE SYSTEMS INTEGRATION

The **Defence Systems Integration** group develops and applies concept generation techniques and innovative systems integration for evolving joint capability.

FORCE DESIGN

The **Force Design** group develops and applies analytical methods to plan and shape a force posture that is affordable, effective and efficient. This includes the design considerations of force preparedness, presence and structure, which are informed by both the military and enterprise strategies.

JOINT SIMULATION, EXPERIMENTATION AND WARGAMING

The **Joint Simulation, Experimentation and Wargaming** group develops and applies advanced joint experimentation and simulation techniques aimed at immersing warfighters and senior decision-makers in the problem domains to understand capabilities and concepts; and to support their understanding of future joint capabilities.

JOINT WARFARE MATHEMATICAL SCIENCES

The **Joint Warfare Mathematical Sciences** group develops and applies mathematical models, quantitative operations research techniques and quantitative analytics for Joint Capability.

STRATEGIC ANALYSIS

The **Strategic Analysis** group develops and applies analytical tools and techniques to support strategic decision-making with respect to strategic security and risk, emerging threats, scenario planning, capability prioritisation, enterprise balance of investment and resource allocation, force generation and capstone concepts development that can meet the demands of extant strategic policy.

TECHNOLOGY FORESIGHTING AND FUTURES

The **Technology Foresighting and Futures** group engages in horizon-scanning and undertakes 'deep dives' to identify and determine the nature and impacts of emerging science and technology.

World-class capabilities and infrastructure



EDTAS

The Emerging Disruptive Technology Assessment Symposia are considered to perform a whole-of-nation function in bringing stakeholders together to explore blue sky innovations that have national and international potential.

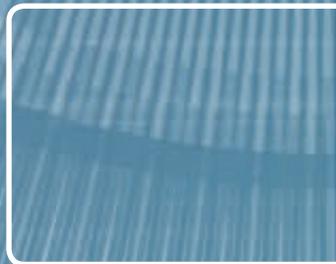
RISK ANALYSIS

The risk analysis methodologies, applying risk contours and risk-in-depth concepts, conducted within the Strategic Analysis group is widely cited in the risk management domain.



FUTURES ACTIVITIES

The DST Futures activities are held in high regard within the Australian and International foresighting community. A key example is the Strategic S&T Outlook which is bringing together input from across DST and Defence to inform decision makers of potential emerging technology opportunities and challenges. The HEADSTART Futures Wargame seeks to understand what might be required of the ADF in the future operating environment.





Australian Government

Department of Defence

Science and Technology

National Security and ISR Division

Intelligence Analytics

Goal

Intelligence Analytics adds value to Australia's defence and national security by improving the situational awareness of Australian intelligence analysts.

Impact

Biometrics: Biometrics has informed the procurement strategy for the Australian Passports Office through studies into facial recognition algorithms, developed eFace technology, and assisted with the National Biometrics Matching Capability with the Australian intelligence community.

Information fusion: Information fusion capabilities are of high impact to Defence and are sought after by allied nations. The MSTC's expertise enables Defence to engage in Five Eye collaboration effectively through various international programs (TTCP and Squaredance) and leverage the outcomes.

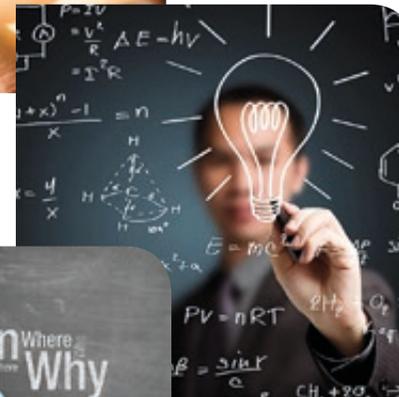
Visual analytics: Development of analytic software to mitigate procurement risk of DEF 100 by refining requirements for Geospatial Intelligence analysts.

Social media analysis: Providing intelligence value from open source INT for Army situational understanding and national security clients – includes human domain understanding, information dissemination and influential actors.



ANALYTIC INTERACTION

LANGUAGE TECHNOLOGY AND FUSION



HUMAN AND SOCIAL MODELLING AND ANALYSIS



BIOMETRICS

MULTI-INTELLIGENCE ANALYTICS

S&T excellence

THREE YEAR PUBLICATION RECORD

- 16 DST technical reports
- 30 DST client reports
- 23 Journal publications
- 30 Conference papers
- 4 Book chapters

PEER RECOGNITION

- TTCP Contested Urban Environment Strategic Challenge (CUESC) Australian Tech Lead
- 11 Adjunct University Appointments
- 2 ARC Assessors
- 4 PhD Supervisors
- 13 Professional memberships

AWARDS

- 3 Australian Operational Service Medals with 4 clasps 2014
- Australian Intelligence Community Team Award 2016
- DST SRI Fellowship 2015–18
- IEEE Harry Rowe Mimno Paper Award 2015
- DIF Fellowship – Squaredance integree

Partnerships and outreach

UNIVERSITIES

- Flinders University
- University of South Australia
- University of NSW
- University of Adelaide
- University of Melbourne
- Swinburne University
- Queensland University of Technology
- Victoria University

INDUSTRY

- Swordfish
- Cognitec
- NEC
- SAFRAN
- 3M
- Aware
- Westbourne
- Raytheon

- CSRA
- appen
- LDC
- Data to Decisions CRC
- Consilium
- Source Forge

GOVERNMENT

- Australian Intelligence Community
- CSIRO, DATA 61
- Government of South Australia

INTERNATIONAL

- TTCP C4I Group
- TTCP Contested Urban Environment Strategic Challenge (CUESC)
- Squaredance
- US Intelligence Community
- DARPA, ONR, ARL (US)

S&T capabilities

ANALYTIC INTERACTION

The **Analytic Interaction** group conducts applied research in human-computer interaction to support the efficient processing, structured analysis and collaborative assessment of all-source – including open-source – intelligence.

LANGUAGE TECHNOLOGY AND FUSION

The **Language Technology and Fusion** group develops analytical tools and techniques to assist analysts to process, analyse and manage their large volumes of unstructured and structured natural language content.

HUMAN AND SOCIAL MODELLING AND ANALYSIS

The **Human and Social Modelling and Analysis** group provides support to analysts to enhance understanding of threats arising from social conflict and terrorism, and also to develop ways to improve analysts' capabilities.

BIOMETRICS

The **Biometrics** group conducts research, development and trials of biometric systems, including both machine and human aspects.

MULTI-INTELLIGENCE ANALYTICS

The **Multi-Intelligence Analytics** group is oriented toward the transition of intelligence capability into operational intelligence environments for Defence and national security stakeholders.

World-class capabilities and infrastructure

SOCIAL INFLUENCE

Being supported by leading research at University of Melbourne, Social Influence is comparable to state-of-the-art in the US Intelligence Community.

BIOMETRICS

Work on multi modal is leading edge while eFace is world-class.

ALL SOURCE ANALYTICS

CONSENSUS multi-INT fusion is potentially a world-leading capability which has been acknowledged by the client community.

LANGUAGE AND FUSION

Aspects of the Language and Fusion work are world-class, particularly the work on CONSTELLATION which holds promise of delivery capability to the Five Eyes community.



Information Integration

Goal

To analyse, develop and demonstrate advanced integrated intelligence, surveillance and reconnaissance (ISR) capabilities supporting Defence decision superiority.

Impact

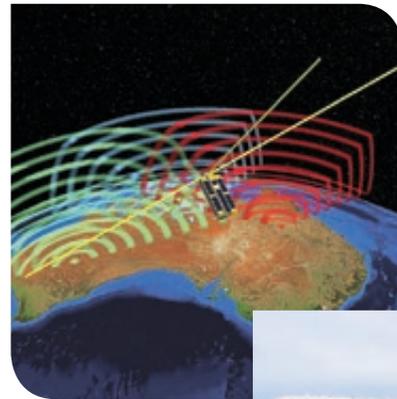
Strategic ISR systems analysis: S&T solutions that facilitate the integration of new AIR 7000 ISR capabilities into the Defence enterprise.

ELIIXAR: The Evolutionary Layered Integrated ISR eXemplar ARchitecture provides S&T guidance for enterprise ISR capability development and Defences's acquisition methodologies.

SERVAL: A DST pilot project to develop cost-effective, high quality geospatial imagery from commercial satellites to users across Defence.

Multi-sensor tracking: DST's advanced algorithms underpin the ISR capabilities of the Jindalee Operational Radar Network and the Wedgetail airborne early warning and control aircraft.

Small satellite missions: Biarri and Buccaneer are positioning Defence to exploit responsive, low-cost space-based capabilities. Missions launched and operational.



STRATEGIC SYSTEMS ANALYSIS



DATA AND INFORMATION FUSION



INFORMATION ARCHITECTURES

S&T excellence

THREE YEAR PUBLICATION RECORD

- 11 DST technical reports
- 37 DST client reports
- 20 Journal publications
- 30 Refereed conference papers
- 2 Books
- 2 Theses

PEER RECOGNITION

- 3 Adjunct university appointments
- 2 ARC assessors
- 3 PhD supervisors
- 2 PhD examiners
- 5 journal reviewers
- 2 IEEE Journal Associate Editors
- 1 IEEE Aerospace and Electronic Systems Board of Governors member
- TTCP ISTAR Group National Representative

AWARDS

- DST awards for Outstanding Contribution to Defence outcomes: Wedgetail support (2014), Sampson Flat bushfires support (2015)
- DST award for Science Excellence: MH370 search contributions (2015)
- 5 Best Paper awards at international Information Fusion conferences

Partnerships and outreach

UNIVERSITIES

- University of Queensland
- University of South Australia
- RMIT
- Curtin University
- University of Melbourne
- Monash University
- University of New South Wales (Sydney and Canberra)
- Sydney University
- Western Sydney University
- Australian National University

INDUSTRY

- Boeing Defence Australia
- BAE Systems
- Price Waterhouse Coopers
- Rheinmetall Defence
- Bayesian Intel
- Digital Globe
- Lockheed Martin
- Mediaware
- Northrop-Grumman
- Inovor Technologies
- Airbus Defence and Space

INTERNATIONAL

- TTCP ISTAR Group
- Dstl (UK)
- Research Institute for Applied Sciences – FGAN (Germany)
- Square Dance
- Responsive Space MOU
- Naval Postgraduate School (US)

S&T capabilities

STRATEGIC SYSTEMS ANALYSIS

The **Strategic Systems Analysis** group develops and applies techniques and tools for the assessment of strategic ISR systems and capabilities, and leads DST's small satellite program to position Defence to exploit emerging low-cost space access opportunities.

DATA AND INFORMATION FUSION

The **Data and Information Fusion** group develops and assesses novel algorithms for target tracking, sensor management and identification to support major Defence projects and new capabilities, including space situation awareness to automatically track orbiting satellites and space debris.

INFORMATION ARCHITECTURES

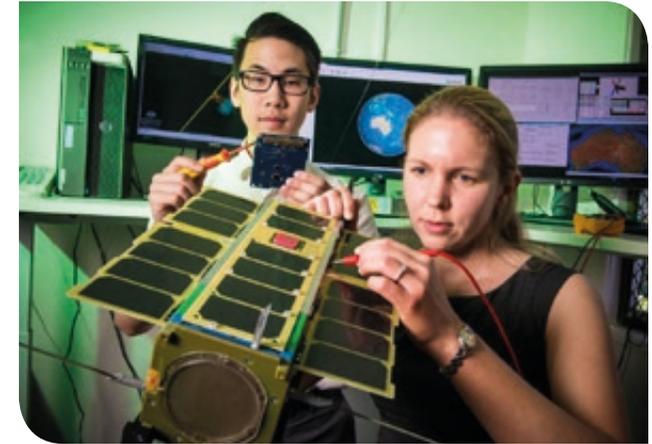
The **Information Architectures** group develops and trials exemplar enterprise integrated ISR and geospatial integration capabilities for Defence using modern agile system development methodologies, supporting Defence situation awareness for enhanced decision superiority.

World-class capabilities and infrastructure



MULTI-SOURCE TRACKING AND FUSION

The Data and Information Fusion group is assessed as world-class, with an impressive publication list, awards, citations and honorary appointments. The group provides essential support for the Jindalee Operational Radar Network, the upgrade of the Wedgetail aircraft, and the acquisition of the F-35A multi-role fighter aircraft.



SMALL SATELLITE PROGRAM

The small satellite team has demonstrated its leading capabilities to develop, integrate, launch and operate small satellites with the potential to revolutionise Australian defence space capabilities.

ISR INTEGRATION EXEMPLAR CAPABILITY

The Information Integration MSTC demonstrated world benchmark capabilities in building enterprise integrated ISR exemplar systems and transitioning these into joint and coalition operations.

Intelligence Systems

Goal

Research, develop and transition advanced Geospatial Intelligence (GEOINT), imagery Measurement and Signatures Intelligence (MASINT), and automated GEOINT processing to enhance Australia's ISR capabilities.

Impact

Advanced sensing: With research and development of advanced sensing techniques for complex environments using hyper-spectral and imaging radar, the MSTC has demonstrated technologies in airborne trials which enhance the ADF's capabilities for ISR and equipment signatures.

MASINT techniques: New persistent techniques demonstrated leading to operational evaluation, new temporal techniques trialed and demonstrated with international partners supporting new capabilities for Defence.

Automated GEOINT processing: New techniques and processing capabilities leveraging multi-algorithmic and machine learning approaches have been transitioned to limited operations and demonstrated for real-time detection of targets.



S&T excellence

THREE YEAR PUBLICATION RECORD

- 7 DST technical reports
- 5 Journal publications
- 24 Conference papers
- 7 Project arrangement reports

PEER RECOGNITION

- 1 ARC and 1 NASA reviewer
- 4 PhD examiners, 4 PhD Supervisors
- 2 PhD Awards, 2 Visiting Research Fellows
- 9 Journal reviewers
- TTCP Contested Urban Environment Lead
- TTCP ISTAR Group Australian Lead

AWARDS

- 3 Square Dance Arnold Awards 2013, 2014, 2016
- Meritorious Unit Citations 2015, 2016
- 5 Australian Operational Service Medals (Civilian) 2013 (4), 2014 (1)
- NATO Award 2013, 2014
- US Defence National Intelligence Citation 2012
- DST Awards 2014, 2015, 2016, 2018

Partnerships and outreach

UNIVERSITIES

- University of Adelaide
- University of NSW
- University of Technology Sydney
- Swinburne University
- University of Western Australia

INDUSTRY

- Rheinmetall
- BAE Systems
- Hawker Pacific
- Lockheed Martin
- Swordfish
- SAAB Systems
- Vcorp
- Data to Decisions (D2D) CRC

GOVERNMENT

- CSIRO
- Bureau Of Meteorology
- Department of Foreign Affairs and Trade

INTERNATIONAL

- Square Dance
- TTCP ISTAR Group
- Dstl (UK)
- NATO STO
- AFRL, NRL, ARL (US)

S&T capabilities

ADVANCED GEOSPATIAL-INTELLIGENCE EXPLOITATION

The **Advanced Geospatial Intelligence Exploitation** group conducts research and development in algorithms, tools, techniques and environments for GEOINT image analysis and exploitation, including the automated fusion of multi-INT sources within the geospatial context.

ELECTRO-OPTIC PROCESSING AND EXPLOITATION

The **Electro-Optic Processing and Exploitation** group conducts research and development of visible and infrared phenomenology, sensors, modes, data processing, target detection algorithms and intelligence exploitation.

RADAR PROCESSING AND EXPLOITATION

The **Radar Processing and Exploitation** group conducts research and development in imaging radar phenomenology, sensors, modes, advanced data processing, target detection algorithms and intelligence exploitation.

World-class capabilities and infrastructure



ANALYST DETECTION SUPPORT SYSTEM

This is a world-class platform that enables transition of R&D through to operations. It is an example in which the MSTC has transitioned world-leading capabilities to their clients to the benefit of Australian Defence.

VIRTUAL LABORATORY

The MSTC's contributions to partnering in the Square Dance collaboration is world-leading in that they exceed scale, and the quality of innovation is without peer.

Surveillance and Reconnaissance Systems

Goal

To provide Australia with a surveillance and reconnaissance edge by exploiting active and passive radar technologies, advanced signal processing, and radar signature prediction, measurement and exploitation.

Impact

Wedgetail: Provided critical technical advice and solutions to enable the Wedgetail system to provide the world's best Airborne Early Warning and Control capability. Provision of ongoing advice on capability edge sustainment.

Signature management: Advised on the control and management of the radar signatures of ADF systems and platforms, and provided time critical support to operations.

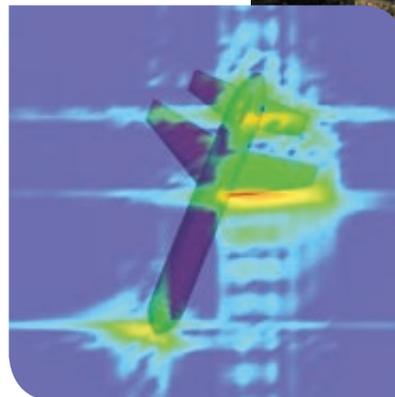
Radar system evaluation: Conducted research and provided advice to enable the ADF to make appropriate decisions regarding selection, use and expected performance of radar systems.

Passive radar: Demonstrated the operational effectiveness of passive radar technology to the ADF.



SURVEILLANCE
MODELLING
AND ANALYSIS

MICROWAVE RADAR
SYSTEMS



SIGNATURES AND
PHENOMENOLOGY

S&T excellence

TWO YEAR PUBLICATION RECORD

- 28 DST technical reports
- 26 DST client reports
- 44 Journal publications
- 79 Conference papers
- 4 Book/book chapters

PEER RECOGNITION

- 1 Adjunct university appointment
- 3 PhD supervisors
- 1 IEEE Aerospace and Electronic Systems Board of Governors member
- 4 journal reviewers
- TTCP ISTAR Group Technical Panel Australian Lead
- NATO SET Panel Australian Lead

AWARDS

- Gold award for excellence in public sector management 2013
- DST Award for Outstanding Contribution to Defence Outcomes 2014
- DST Award for Science and Engineering Excellence 2016
- Best Paper Awards at International Radar Conference 2014, 2015

Partnerships and outreach

UNIVERSITIES

- University of Adelaide
- University of South Australia
- University of Melbourne
- RMIT
- University of Queensland
- Curtin University
- Macquarie University
- University of NSW Canberra

INDUSTRY

- Northrop Grumman
- Boeing Defence Systems
- CEA Technologies
- Daintree Systems
- Rheinmetall Defence
- Silentium Defence
- Solinnov, Raytheon
- Teledyne Australia

INTERNATIONAL

- TTCP ISTAR Group
- NATO SET Panel
- NAVAIR, ONR, NRL (US)
- Fraunhofer FHR (Germany)
- Dstl (UK)
- Royal Air Force (UK)
- Leonardo (UK)
- University College London (UK)
- Arizona State University (US)
- University of Dayton (US)
- University of Pennsylvania (US)
- University of Pisa (Italy)
- Colorado State University (US)

S&T capabilities

SURVEILLANCE MODELLING AND ANALYSIS

The **Surveillance Modelling and Analysis** group conducts performance modelling and analysis of surveillance systems, primarily radar systems, including both parametric and signal simulation models that encapsulate the interaction between the radar signal, targets and the background environment.

MICROWAVE RADAR SYSTEM

The **Microwave Radar Systems** group investigates advanced microwave radar technologies for enhanced detection, tracking and identification together with the associated electronic protection techniques, radar waveform design and radar system control.

SIGNATURES AND PHENOMENOLOGY

The **Signatures and Phenomenology** group is responsible for high fidelity electromagnetic analysis, predictions and measurements of radar signatures, including radar cross-section and high resolution radar signatures for target recognition.

World-class capabilities and infrastructure



PASSIVE RADAR

The Passive Radar effort has a high international standing and best practice. The successes in this area represent a demonstration of the high calibre of DST staff and their ability to perform cutting edge R&D.



MARITIME DETECTION AND CLUTTER MODELLING

This is an area of considerable strength and staff have a worldwide reputation in the area. They are also gaining a significant reputation in the area of maritime ISR.

High Frequency Radar

Goal

Conduct R&D into high-frequency over-the-horizon radar to enhance and sustain Australia's wide-area air and surface vessel surveillance capability.

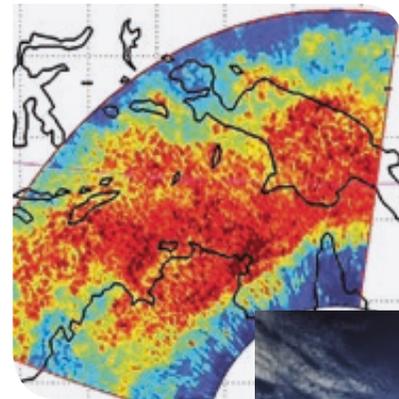
Impact

Operations: JORN daily support: R&D transitioned to capability with extended coverage, improved detection sensitivity, clutter and interference rejection, EW suite.

Sustainment: JORN component replacement integrity; development of specialised equipment design options.

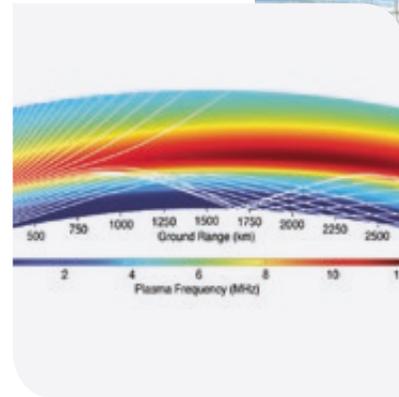
Acquisition: Capability options; technical and industry workforce risk reduction through the JORN Priority Industry Capability (PIC) Program; system design and assessment; modelling; experimentation and demonstration.

Future Proofing: New radar design and high-fidelity instrumentation aiming for significant detection sensitivity and persistence improvement.

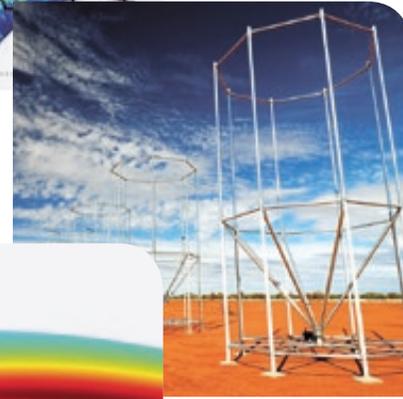


SIGNAL PROCESSING AND PROPAGATION

RADAR TECHNOLOGY AND SYSTEMS



GEOPHYSICAL PHENOMENOLOGY AND PERFORMANCE ASSESSMENTS



S&T excellence

THREE YEAR PUBLICATION RECORD

- 6 DST technical reports
- 11 Journal publications
- 25 Conference papers
- 1 Book

PEER RECOGNITION

- 1 ARC College of Experts
- 3 Adjunct Lecturers University of Adelaide
- 1 Member IEEE Radar Systems Panel
- 1 Adjunct Research Fellow University of Adelaide
- 1 IEEE Fellow
- 1 IEEE Senior Member
- 1 IEEE Associate Editor

AWARDS

- US INT Community Award 2016
- 2 DST S&T Excellence Awards 2014

Partnerships and outreach

UNIVERSITIES

- University of Adelaide
- La Trobe University
- RMIT

INDUSTRY

- Lockheed Martin (Aust)
- BAE Systems
- Silenium Defence

GOVERNMENT

- Bureau of Meteorology

INTERNATIONAL

- US Relocatable Over-the-Horizon Radar Program Office
- US Intelligence Community
- NRL, AFRL (US)
- MIT Lincoln Laboratory (US)

S&T capabilities

SIGNAL PROCESSING AND PROPAGATION

The **Signal Processing and Propagation** group conducts research in signal and array processing, cognitive radar, coordinate registration and algorithms and computing architectures for real-time processing.

RADAR TECHNOLOGY AND SYSTEMS

The **Radar Technology and Systems** group develops and fields specialised HF/VHF radar components and sub-systems for understanding radar component behaviour, understanding the connection between component and system performance and for the wider experimental program.

GEOPHYSICAL PHENOMENOLOGY AND PERFORMANCE ASSESSMENTS

The **Geophysical Phenomenology and Performance Assessments** group is concerned with all facets of support and intelligence in relation to HF radar. This includes extensive capability in ionospheric physics.

World-class capabilities and infrastructure



IONOSPHERIC RESEARCH

Publication in peer journals such as Radio Science with minimal revision, as well as refereeing of papers shows the MSTC is an authority in this area. There is a large worldwide user community employing MSTC developed raytracing software.

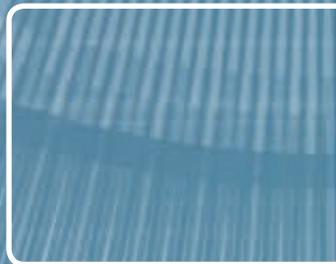


HF RADAR DESIGN AND IMPLEMENTATION

The MSTC has developed over the last 30 years, and continues to refine, world-leading OTHR architectures and algorithms. International partners look to Australia as the world-leader in OTHR science and technology.

HF AUXILIARY SYSTEMS

Offshoots of the HF research science and technology have led to significant developments in alternate configurations and functionality related to national security.





Australian Government

Department of Defence
Science and Technology

Cyber and Electronic Warfare Division



Cyber Assurance and Operations

Goal

To enable the ADF to fight-through in a contested cyber environment with an effective and potent Cyber Warfare capability.

Impact

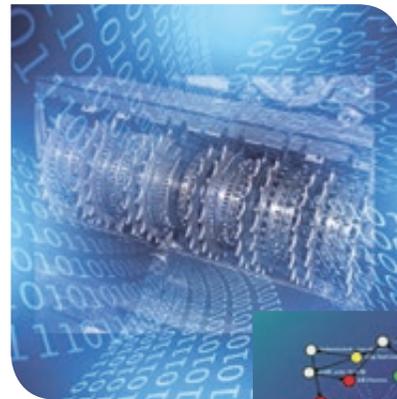
Cryptologic capability: Application of expertise in cryptology and information assurance has ensured the safety and security of ADF troops and Australian Government communications.

Trustworthy and resilient systems: New design approaches for developing trusted foundations for high assurance systems and for the analysis and management of cyber risk in complex military systems.

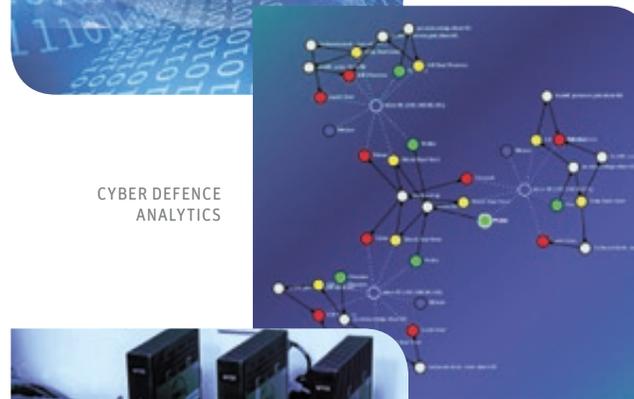
Cyber threat defeat: New program analysis and machine learning techniques to automatically find and characterise cyber vulnerabilities in very large and complex military systems.

Autonomous cyber operations: Shaping the future by strategic research into the application of autonomous capabilities for future cyber operations.

Cyber subject matter experts: Integrated and posted staff have provided valuable contributions to clients, resulting in greatly improved effectiveness, innovative solutions, and improved data visualisation.



CYBER- AND
CRYPTO-MATHEMATICS
RESEARCH



CYBER DEFENCE
ANALYTICS



ACTIVE SECURITY
TECHNOLOGIES

S&T excellence

THREE YEAR PUBLICATION RECORD

- 21 DST technical and client reports
- 6 Journal publications
- 20 Conference papers

PEER RECOGNITION

- Adjunct position and three visiting fellows at Australian National University (ANU)
- Advisory board – Australian Centre for Cyber Security (ACCS)
- Journal reviewers – Microprocessors and Microsystems, ACM Computing Surveys
- Conference Program Committees – Australasian Information Security Conference, Australian Cyber Security Centre Conference, Australasian Web Conference

AWARDS

- Prime Minister's letter of appreciation 2014
- Commendation from US Department of Homeland Security 2015
- ASD Merit Award 2016
- 2 ASD Exceptional Achievement Awards 2016
- ASD Australia Day Awards 2014, 2016
- 2 ASD Certificates of Appreciation 2015
- Australian Industry Skills Committee Best Paper 2015
- South Australian iAward: Digital Video Guard 2014
- National and State iAwards: Cross Domain Desktop Compositor 2017
- Winning team: Man vs Data 2016
- Best Speaker: B-Sides Cyber Security Conference 2017

Partnerships and outreach

UNIVERSITIES

- Australian National University
- University of Melbourne
- University of Queensland
- Deakin University
- Swinburne University
- University of NSW
- University of Newcastle
- University of Adelaide

INDUSTRY

- BAE Systems
- Data to Decisions (D2D) CRC
- Expert Knowledge Group

GOVERNMENT

- Data61/CSIRO

INTERNATIONAL

- TTCP C4I TP42
- US Department of Defense
- Dstl (UK)
- DRDC (Canada)
- US DHS
- Five Eyes

S&T capabilities

CYBER AND CRYPTO MATHEMATICS

The **Cyber and Crypto Mathematics Research** group is located within the Australian Signals Directorate and is strongly focused on addressing operational problems through the application and R&D of mathematics, data science, and high performance computing.

CYBER DEFENCE ANALYTICS

The **Cyber Defence Analytics** group focuses on concepts and technologies for the automated discovery and analysis of vulnerabilities in complex cyber systems. The group has a longer range goal of developing concepts for autonomous cyber operations.

ACTIVE SECURITY TECHNOLOGIES

The **Active Security Technologies** group undertakes research and develops concepts pertaining to the system security of embedded systems and military platforms. Their work encompasses vulnerability assessments through to the development of high assurance systems.

World-class capabilities and infrastructure



ACTIVE SECURITY TECHNOLOGIES TRUSTWORTHY SYSTEMS

Clearly valued by the international community and DATA61/NICTA (National Information and Communications Technology Australia). The Trustworthy Systems research was a primary contributor to the Trustworthy Systems activity of the TTCP Cyber Strategic Challenge. DATA61 and DST won two National iAwards for their collaboration on the Cross Domain Desktop Compositor.



CYBER AND CRYPTO MATHEMATICS RESEARCH

Several projects in cyber and crypto mathematics research are highly commended by international partners and considered world-class. This is further evidenced by invitations to prestigious international workshops and conferences.

CYBER DEFENCE ANALYTICS

The malware analysis research area is highly valued by the intelligence community with their work being applied towards a cyber threat defeat capability for the ADF.

Cyber Sensing and Shaping

Goal

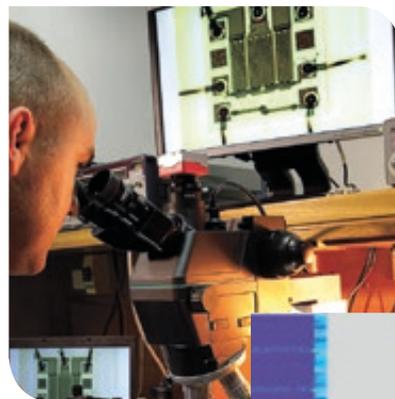
Delivery of concepts, techniques and technologies for sensing and shaping modern communication networks to address challenges in signals intelligence and cyber operations.

Impact

Operational support: Provision of unique enabling S&T capability and SME advice to the Australian Intelligence Community and ADF; enduring presence at the Joint Defence Facility Pine Gap.

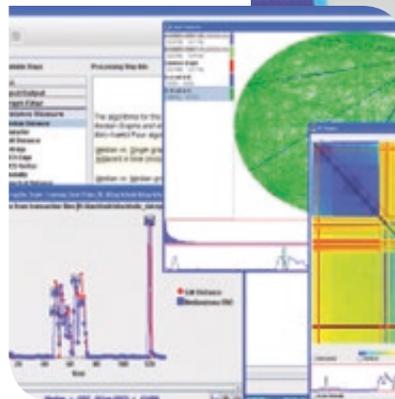
Operational technologies: Specialised radio frequency and software defined radio-based waveforms for cyber access and tailored wireless links; delivery of prototype network analytics and technologies; award-winning outcomes through operational signals analysis.

Strategic research: Partnering internationally and within Australia to advance technologies that support the intelligence community and ADF in areas of wireless cyber; cyber situational awareness; laser communications for space and quantum key distribution; covert communications; network routing vulnerabilities; and network anomaly detection.



ACCESS TECHNOLOGIES

COMMUNICATIONS SIGNAL PROCESSING



COMMUNICATIONS NETWORKS RESEARCH

S&T excellence

THREE YEAR PUBLICATION RECORD

- 26 DST technical reports
- 10 Journal publications
- 34 Conference papers

PEER RECOGNITION

- 2 Adjunct academics
- TTCP National Lead for C4I
- TTCP International Lead for C4I/TP42/EM Cyber
- Joint Chair of Signal Intelligence (SIGINT) Applications of Network Analysis Research (SANAR) organising committee
- Supervision of honours and PhD research

AWARDS

- ASD Exceptional Achievement Award 2018
- USG Silver Medal 2017
- CEWD award for client impact 2015
- Five Eyes SIGINT awards 2014
- Australia Day medallion 2013

Partnerships and outreach

UNIVERSITIES

- University of Adelaide
- University of South Australia
- Swinburne University
- University of New South Wales
- University of Technology Sydney
- University of Sydney
- Macquarie University

INDUSTRY

- Ebor
- Data to Decisions (D2D) CRC
- Quintessence Labs

GOVERNMENT

- Australian Signals Directorate
- National Security Agencies
- CSIRO / Data 61
- STEM Professionals In Schools

INTERNATIONAL

- Five Eyes
- International Joint Program at Joint Defence Facility Pine Gap
- NATO STO
- TTCP Cyber Strategic Challenge and C4I
- NRL (US)
- US DHS

S&T capabilities

ACCESS TECHNOLOGIES

The **Access Technologies** group undertakes R&D within the physical layer for cyber access and tailored wireless links. Access Technologies comprises Radio Frequency Technologies; Covert Communication Waveforms; and Photonics Disciplines.

COMMUNICATIONS SIGNAL PROCESSING

The **Communications Signal Processing** group conducts R&D for vulnerability discovery in wireless communication signals and systems. Communications signal processing comprises Disciplines: Signals Analysis; and Wireless Cyber.

COMMUNICATIONS NETWORK RESEARCH

The **Communication Networks Research** group conducts research and development in communication networks to provide timely network situational awareness, undertake cyber operations and to improve network security. Communications networks research comprises network technologies; network knowledge; and network analytics disciplines.

World-class capabilities and infrastructure



SIGNALS ANALYSIS

The analysis of physical layer communications signals has had considerable operational impact in an international partnership and has been acknowledged through international awards.

WIRELESS CYBER

An emerging area of growing client importance that explores cyber vulnerabilities introduced through the electromagnetic spectrum.

NETWORK TECHNOLOGIES

Development of concepts and analytical tools to support network operations and vulnerabilities identification.

COVERT COMMUNICATIONS WAVEFORMS

Theory is benchmarked through a strong international publishing track record and technical solutions that are providing (client) missions with unique capability.

PHOTONICS

Capability for development of bespoke photonic sensing and communications technology that has demonstrated leading-edge performance.

Assured Communications

Goal

Enable the ADF to dominate the wireless communications environment by protecting ADF communications and degrading adversary communications, thus achieving freedom of operations in wireless communications.

Impact

Saving lives: Prevented battlefield casualties of ADF and coalition soldiers by developing practical systems that defeat improvised explosive devices. Over 190,000 protection units delivered with many lives saved over the past few years.

Protected satellite communications: Delivered specialised satellite communications for submarines and land vehicles on the move. Built customised communications monitoring and management systems for ADF network operations centre.

Survivable networks research: Developed novel autonomous unmanned air vehicle systems that maintain radio communications networks under electronic warfare attack. Built a unique optimisation planning tool for mobile tactical networks.

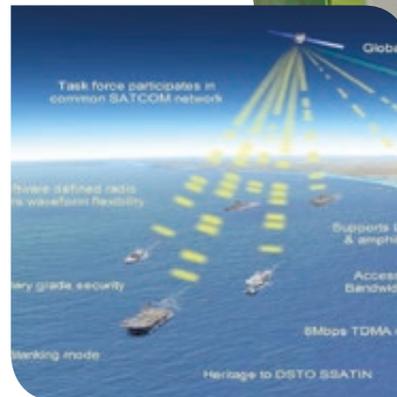
Protocol exploitation: Delivered low signature Electronic Warfare techniques. Developing novel waveforms and machine learning systems that can respond to zero-day electronic attacks. Developing solutions to mitigate radio interference and protect against electronic attacks.



COMMUNICATIONS
ELECTRONIC
WARFARE



SURVIVABLE
NETWORKS



PROTECTED
SATELLITE COMMS

PROTOCOL
EXPLOITATION

S&T excellence

THREE YEAR PUBLICATION RECORD

- 13 Journal publications
- 93 DST client reports
- 62 Conference papers
- 28 Other publications

PEER RECOGNITION

- Adjunct Academics (x2) – University of SA
- PhD supervisor
- TTCP C4I Group Technical Panel Lead

AWARDS

- Clunies Ross Knowledge Commercialisation Award 2017
- Public Service Innovation Award – REDWING Team 2016
- Best Paper Future Land Force Conf. 2016
- DST Awards 2015 – MH370 Aircraft investigation, OASIS and REDWING Teams
- Highly Commended Paper IEEE ITNAC Conference 2015
- Chief of Navy SATCOM Commendation 2015

Partnerships and outreach

UNIVERSITIES

- University of Sydney
- University of South Australia
- University of Adelaide
- Monash University
- University of New South Wales (Australian Defence Force Academy)

INDUSTRY

- L3 Micreo
- Axiom
- Lintek
- Ultra Avalon
- Solinnov
- EM Solutions
- ZCG Scalar
- Rohde & Schwarz

GOVERNMENT

- Data61
- Attorney General's Department
- ANZ Counter-Terrorism Committee
- State and Federal Police
- Australian Transport Safety Bureau

INTERNATIONAL

- TTCP Electronic Warfare Systems and C4I Groups
- TTCP EM Cyber Challenge
- Naval Postgraduate School, SPAWAR, NRL (US)
- AFRL (US)
- CERDEC, TARDEC (US)
- Five Eyes Electronic Countermeasure Working Group
- Five Eyes MILSATCOM Forum
- Dstl (UK)

S&T capabilities

COMMUNICATIONS ELECTRONIC WARFARE

The **Communications Electronic Warfare** group focusses on developing countermeasure techniques, specialised systems and devices that provide force protection against high level improvised explosive device threats.

SURVIVABLE NETWORKS

The **Survivable Networks** group undertakes R&D in the survivability of tactical radio networks operating in contested and denied environments. Particular emphasis is placed on using dynamic, autonomous platforms and planning optimisation tools.

PROTECTED SATELLITE COMMUNICATIONS

The **Protected Satellite Communications** group undertakes R&D and international collaboration to enhance and defend ADF SATCOM in contested environments. The activities cover the strategic SATCOM enterprise core through to specialised waveforms for ADF platforms.

PROTOCOL EXPLOITATION

The **Protocol Exploitation** group undertakes R&D and provides science and technology advice on robust radio communications in contested, complex and unpredictable electromagnetic environments.

World-class capabilities and infrastructure



COUNTER IED

The Counter-IED work program is a world benchmark capability that is well respected within the Five Eyes community and as confirmed by the client, the quality of deliverables is well in excess of what could be reasonably expected. Australian force protection equipment is on par with the US and UK.



SATCOM WAVEFORM DEVELOPMENT

The OASIS and SATCOM-on-the-Move protected waveform work is world-leading as evidenced by international collaboration, client feedback and knowledge of the review panel experts. The OASIS solution addresses an existing critical operation issue.

Systemic Protection and Effects

Goal

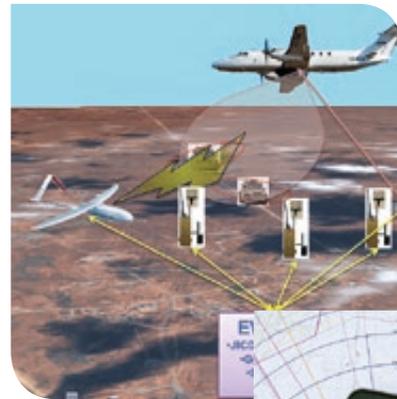
Maximise ADF and national security capability through the development and delivery of solutions for the integration of force-level cyber and electronic warfare with effective command and control.

Impact

Joint Force Level Electronic Warfare (JFLEW): Through close engagement with Airborne Electronic Attack and Joint Intelligence, Surveillance, Reconnaissance and EW (ISR&EW) Defence programs, the MSTC has contributed to the implementation of JFLEW. Experimentation with user groups, international exercises and engagement with overseas partners has led to developing C2 tools for JFLEW.

F/A-18 threat geolocation: Close collaboration with the US Navy has led to significant improvements to USN and Defence's emitter location and classification capability, and is in the process of transitioning to Australian Air Force and US Navy aircraft.

Position navigation and timing (PNT) resilience: Through the development and application of advanced PNT threat concepts and other initiatives, the MSTC has contributed to the assured access of PNT for the ADF. The work of MSTC has also provided training and operational test and evaluation opportunities in GPS degraded environments.



DISTRIBUTED
ELECTRONIC WARFARE
EXPERIMENTATION
AND SIMULATION



POSITION NAVIGATION
AND TIMING TECHNOLOGY
AND SYSTEMS



AUTOMATED ANALYTICS
AND DECISION SUPPORT

S&T excellence

THREE YEAR PUBLICATION RECORD

- 19 DST technical reports
- 22 DST client reports
- 12 Journal publications
- 23 Conference papers
- 1 Book chapter

PEER RECOGNITION

- Two adjunct professorships – Adelaide University and University of South Australia
- Two PhD supervisors
- TTCP EWS Group and Panel national leads

AWARDS

- TTCP Awards 2016, 2017
- USN Commendation 2016
- Canadian Commendation 2016
- 4 DST Commendations

Partnerships and outreach

UNIVERSITIES

- Australian National University
- Adelaide University
- University of NSW
- Melbourne University

INDUSTRY

- Aerosonde (AAI)
- Consunet, Swordfish
- Simbiant
- SAAB
- GPSat Systems
- JEDS

GOVERNMENT

- National Positioning
- Infrastructure
- CSIRO

INTERNATIONAL

- TTCP EWS Group
- AFRL (US)
- NRL, NAVAIR (US)
- Five Eyes, 11 Eyes GPS MOUs
- US Geo-spatial Agency
- DRDC (Canada)

S&T capabilities

DISTRIBUTED ELECTRONIC WARFARE EXPERIMENTATION AND SIMULATION

The **Distributed EW Experimentation and Simulation** group integrates EW systems, sensors, effectors and battle management tools/ concepts within an information warfare construct to examine force-level EW concepts and analyse military systems.

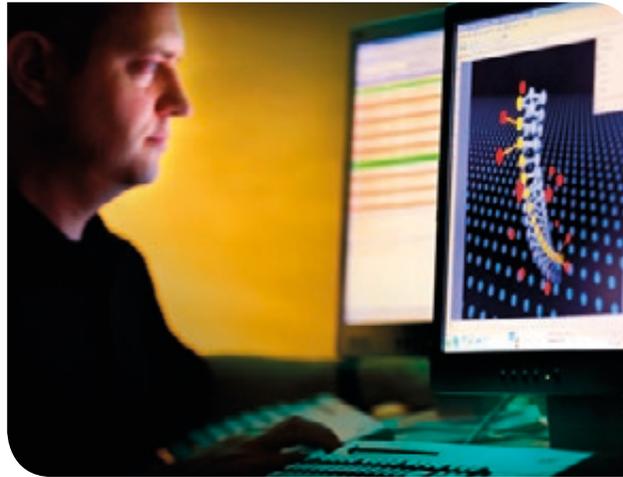
POSITION, NAVIGATION AND TIMING TECHNOLOGIES AND SYSTEMS

The **Position Navigation and Timing (PNT) Technologies and Systems** group develops techniques for denying PNT to adversaries while maintaining our own PNT against electronic attack.

AUTOMATED ANALYTICS AND DECISION SUPPORT

The **Automated Analytics and Decision Support** group undertakes research and development in concepts, technologies and techniques for the understanding of the current and projected state of our own, and adversary, cyber physical systems.

World-class capabilities and infrastructure



DISTRIBUTED ELECTRONIC WARFARE

Working with Defence and industry stakeholders on EW resource management has delivered commanders the ability to manage and control multiple networked assets. The group's efforts in Distributed Electronic Warfare are recognised worldwide.

NAVIGATION WARFARE

The work on Navigation Warfare is recognised nationally and internationally. Staff serve as trusted advisors on all matters of S&T and technical decisions. Staff are well respected members of the Navigation Warfare (NAVWAR) MOU.

MISSION ASSURANCE AND DECISION SUPPORT

The quality of the research being done on Cyber Mission Assurance was assessed as being a world-benchmark by an independent external international review team.

Spectrum Sensing and Shaping

Goal

To lead collaborative research, development and transition of RF technologies, systems and techniques that sense, shape and exploit the electromagnetic battlespace to enable the ADF and partners to dominate operations in complex, congested and contested environments.

Impact

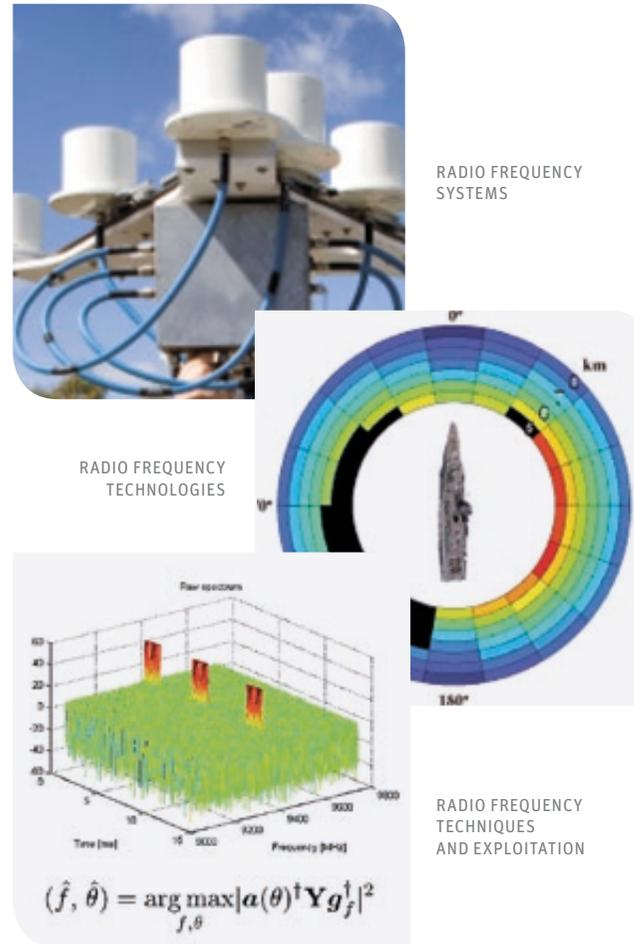
Nulka: Ongoing support to multiple phases of SEA 1397, ensuring the protection of RAN major combatants against current and future anti-ship missile threats. Development of radio frequency (RF) technologies and low size weight and power electronic warfare payloads to support the future force.

Wideband and multi-channel digital electronic support systems:

Development and transition of world-leading wideband and multichannel digital electronic support systems resulting in improved ADF electronic support and signals intelligence capabilities. Prototype wideband system is being evaluated for use used in cooperative program with the US Navy.

Electronic support and signals intelligence data deluge: Algorithms and applications have been developed and transitioned to enhance ADF electronic support and signals intelligence capabilities in future electromagnetic (EM) operating environments.

Enhanced situational awareness: Algorithms and applications developed and transitioned to enhance ADF situational awareness, including environmental effects, in future EM operating environments.



S&T excellence

FOUR YEAR PUBLICATION RECORD

- 12 DST technical reports
- 7 DST client reports
- 21 Journal publications
- 50 Conference papers

PEER RECOGNITION

- 4 Adjunct Senior Lecturers
- PhD Co-supervisors
- Advisory committee – Adelaide University
- TTCP EWS Group TP6 National Leader
- AOC Board Member
- IEEE Senior Fellow

AWARDS (PAST FOUR YEARS)

- DST Achievement Award 2015, 2016, 2017
- DST Team Achievement Award 2015 (2), 2016
- TTCP EWS Team Award 2017
- First Prize Student Paper 2015
- Top 3 most downloaded papers in IEEE Transactions on Antennas and Propagation, 2015

Partnerships and outreach

UNIVERSITIES

- Macquarie University
- Adelaide University
- University of Sydney
- Flinders University

INDUSTRY

- Microe
- BAE Systems
- Ultra Electronics
- Jenkins Engineering Defence Systems
- Solinov, Macom, Lintech,
- Puzzle Precision, Curtiss-Wright

GOVERNMENT

- CSIRO
- Bureau of Meteorology
- Australian Institute of Marine Science

INTERNATIONAL

- TTCP EWS Group
- ONR, NAVAIR, NAVSEA, SPAWAR (US)
- Dstl (UK)
- Arizona State University (US)
- Air and Space Interoperability Council (Five Eyes)

S&T capabilities

RADIO FREQUENCY SYSTEMS

The **Radio Frequency Systems** group undertakes research and development with respect to next generation RF EW architectures and systems for surveillance, threat warning and situational awareness, with a focus on commercial-off-the-shelf based wideband RF sensors and digital multichannel processing architectures.

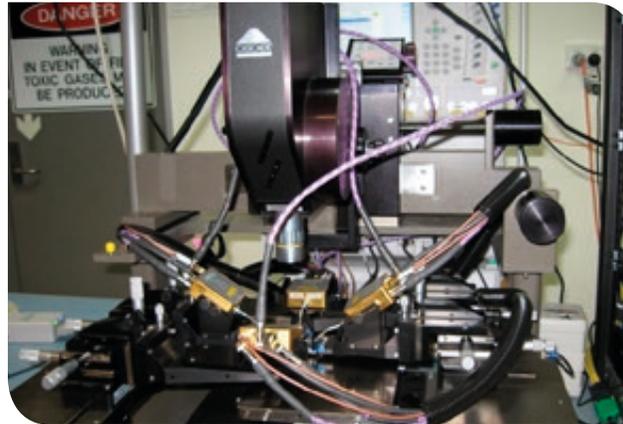
RADIO FREQUENCY TECHNOLOGIES

The **RF Technologies** group undertakes analysis and development of subsystems and systems for next generation RF EW sensors and effectors for self-protection and survivability.

RADIO FREQUENCY TECHNIQUES AND EXPLOITATION

The **RF Techniques and Exploitation** group undertakes mathematical, statistical and knowledge-based algorithm development and implementation for RF signal detection, characterisation, localisation and identification. This includes an emphasis on wideband and multichannel RF signal processing and machine learning, graphic processing unit implementation and tactical tools development.

World-class capabilities and infrastructure



RF TECHNOLOGIES

The research in the area of propagation modelling at high frequencies in the maritime domain is world benchmark. The MSTC also conducts innovative research associated with the design of state-of-the-art radio frequency integrated circuit components and has a long history of expertise in the development and fielding of size, weight and power constrained off-board countermeasure technologies. The application of this capability to digital wideband processing and the multi-channel/multi-aperture domain is world-leading.



6 GHZ AND 15 GHZ WIDEBAND/ULTRA-WIDEBAND DIGITAL INTERCEPT RECEIVER

The current 6GHz receiver is comparable to the best in the world and the upcoming 15GHz version will consolidate the MSTC's status as frontrunners in this technology.

ELINT AND ESM SIGNAL ANALYSIS

The capability has developed its expertise in signal analysis for Electronic Intelligence and Electromagnetic Spectrum analysis over 20 years. This body of knowledge has been brought together to a great degree first in the IDEA software suite and now in the Sherlock and WASP software suites.

Electronic Warfare Operations

Goal

Develop technologies and techniques to improve ADF survivability by understanding, detecting and defeating threats using the electromagnetic spectrum.

Impact

Countermeasure development and validation: A formal process involving RAAF and DST delivering countermeasures to enhance air-platform survivability against threat weapons. The CMD&V system is fully operational and covers 13 ADF aircraft types.

Threat evaluation: Advanced techniques are developed to address the emerging threat environment, providing the knowledge and understanding that underpins countermeasure development.

Laser technology development: World-leading fibre laser technology offers revolutionary Defence capability for sensing, countermeasures and directed energy effects. A growing intellectual property portfolio has been established, with a Directed Infrared Countermeasure laser having been licensed to industry and successfully marketed internationally.



S&T excellence

THREE YEAR PUBLICATION RECORD

- 52 DST technical reports
- 33 DST client reports
- 77 External publications
- 8 Joint publications

PEER RECOGNITION

- ARC assessor
- University academic board member
- Int. conference subcommittee chair
- Adjunct Senior Lecturer (USA)
- Australian Industry Participation National Executive member
- PhD co-supervisor
- TTCP EWS National lead

AWARDS

- PM's Award for Excellence in Public Sector Management 2013
- PM's Award for Innovation 2013
- Australia Day Medallion 2016
- UK MoD CSA Commendation Award 2013
- 2 NATO STO Awards 2013, 2014
- TTCP Achievement Award 2017
- Defence Support Services Commendation Gold and Bronze Awards 2015
- DST Awards 2013, 2014, 2015, 2017
- SPIE best paper award 2015

WORLD RECORDS

- 400 W 2.1um CW fibre laser
- 99 W MWIR DIRCM laser source

Partnerships and outreach

UNIVERSITIES

- Adelaide University
- University of South Australia
- Macquarie University
- University of Sydney
- Flinders University

GOVERNMENT

- AFP

INDUSTRY

- BAE Systems
- Airbus Group Australia Pacific
- Chemring
- Thales
- elmTek
- SysTech
- Sub-Micron
- Aether Photonics

INTERNATIONAL

- TTCP EWS Group
- NATO STO
- Dstl (UK)
- DRDC (Canada)
- MELCO, Shinkosha (Japan)
- Airbus DS (Germany)
- Deutsches Elektronen-Synchrotron (Germany)
- AFRL, NRL, ONR (US)
- NAVSEA, NAVAIR, NSWC (US)
- Missile & Space Intelligence Centre (US)
- National Air and Space Intelligence Centre (US)
- ASE/CTE (US)
- Nufern (US)
- ADD-ROK (Korea)
- University of Southampton (UK)
- Rochester Institute of Technology (US)

S&T capabilities

RADIO FREQUENCY ELECTRONIC ATTACK

The **RF Electronic Attack** group develops technologies and techniques to counter radars and radar guided weapons, including complex modern systems that may be networked and capable of adapting to the physical and operational environment.

ELECTRO-OPTIC COUNTERMEASURES

The **Electro-Optic Countermeasures** group undertakes research on EO technologies and techniques to provide tactical situation awareness, and to counter threats using novel pyrotechnic or laser countermeasures.

LASER TECHNOLOGIES

The **Laser Technologies** group applies deep expertise in laser science to conceive and develop laser systems for bespoke Defence applications. These include detecting and countering of threat optical systems, and using high power laser radiation as a weapon.

World-class capabilities and infrastructure



FIBRE LASERS

EW Operations has a world-leading capability to design, build and characterise high power fibre lasers. This is evidenced by numerous world records for power and efficiency, particularly in the 2µm wavelength band of interest for Defence applications.

ELECTRO-OPTIC HARDWARE-IN-THE LOOP FACILITY

The MSTC has established a capability for scientists and ADF personnel to test countermeasure techniques for specific threats and scenarios. This is a rare synergy of a research and operational facility, and the concept has been adopted by Australia's major allies.

RADIO FREQUENCY COUNTERMEASURE TESTBED

This facility allows the design and testing of complex RF countermeasure techniques. It can be operated in remote locations or at sea, and fulfils a critical role in the gap between science and operational capability.

LASER OPTICAL COUNTERMEASURE SYSTEM

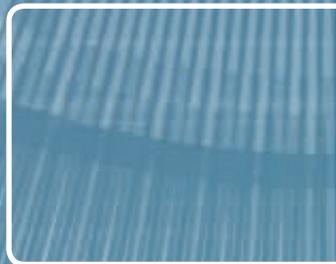
LOCS is a system that detects, locates and counters threat optical devices using retro-reflection. It has demonstrated world-class operational utility, and is currently undergoing commercialisation.

HOSTILE FIRE INDICATION

A capability to detect and warn of hostile gunfire directed at an aircraft has been developed and integrated into the AAR-60 passive missile warning system.

COUNTERING PASSIVE RADAR

By working closely with the passive radar team in the National Security and Intelligence, Surveillance and Reconnaissance Division, countermeasure techniques were demonstrated that may defeat the emerging threat of passive radar.





Australian Government

Department of Defence

Science and Technology

Weapons and Combat Systems Division

Tactical Systems Integration

Goal

To enable the ADF to conduct joint and coalition tactical operations with seamless integration and interoperability of current, planned and next generation platforms and systems with tactical decision superiority and high degrees of automation and autonomy.

Impact

Integration: Expediting resilient tactical information management and exchange through the application of advanced networking technologies and information management techniques.

Interoperability: The MSTC has contributed to enhancing capability interoperability in Defence through developing intrinsically interoperable tactical battlespace architectures and distributed information management for advanced joint tactical systems.

Future Architectures: Intrinsically secure and adaptable systems through open, modular, distributed and scalable tactical systems-of-systems architectures.

Decision Superiority: Through the increased use of automation/autonomy and operator decision solutions, Defence is now able to make timely and effective tactical force-level response decisions.

Human teaming: Tactical mission effectiveness in Defence has been enhanced through S&T work on improving solutions for team composition, operations room design, and human-human, human-machine and autonomous/automated teaming.



HUMAN AND AUTONOMOUS DECISION SUPERIORITY



(T13) TACTICAL INFORMATION INTEGRATION AND INTEROPERABILITY



ADAPTIVE INFORMATION ARCHITECTURES

S&T excellence

THREE YEAR PUBLICATION RECORD

- 9 DST technical reports
- 5 DST client reports
- 16 Journal publications
- 2 Conference papers
- 2 Book chapters

PEER RECOGNITION

- 4 Society Memberships
- 1 ARC Examiner
- 1 Adjunct Position
- 5 Journal Reviewers

AWARDS

- 2 Australia Day Council Awards
- 3 TTCP Awards
- DST award 2016

Partnerships and outreach

UNIVERSITIES

- University of Adelaide
- University of South Australia
- University of Western Sydney
- Flinders University/Oregon State

INDUSTRY

- Boeing Defence Australia
- SAAB Australia
- Lockheed Martin Aerospace
- BAE Systems
- Consilium Technologies
- Agent Oriented Systems

INTERNATIONAL

- TTCP AER, MAR, LND and HUM Groups
- NATO STO
- USN , SPAWAR (US)
- Dstl (UK)
- DRDC (Canada)
- Object Management Group (US)

S&T capabilities

HUMAN AND AUTONOMOUS DECISION SUPERIORITY

The **Human and Autonomous Decision Superiority** group conducts research on integrated autonomous and human information assessment and decision making in distributed tactical systems to provide superior decisions and warfighting capability.

TACTICAL INFORMATION INTEGRATION AND INTEROPERABILITY

The **Tactical Information Integration and Interoperability** group conducts research that will ensure that relevant information is discoverable, accessible, available, usable, commonly understandable and actionable by all elements that need it in the tactical battlespace – both human and machine.

ADAPTIVE INFORMATION ARCHITECTURES

The **Adaptive Information Architectures** group researches revolutionary software approaches to connect ADF platforms into a coordinated force that can 'fight through' threats and complex environments. The intent: to form re-configurable systems of sensors, decision algorithms and weapons that can out-adapt adversaries and deliver advantage.

World-class capabilities and infrastructure



MISSION SYSTEM RESEARCH CENTRE

Comprises a set of laboratories and ICT equipment capable of being configured with near-operational software or adaptable testbeds for both near-term and forwarding looking research.



JSF BATTLESPACE AWARENESS

Focuses on research methods and technologies for the automated identification of threats; evaluation of the capabilities and lethality of the threat; and assessment of the ability of the JSF and its systems to defeat the threat.

Tactical Systems Performance Assessment

Goal

To enable a tactical performance advantage for the ADF in complex contested environments, underpinned by innovation in modelling, simulation, analysis and experimentation.

Impact

Sovereign weapons technical intelligence: Deep knowledge of Weapons and Technical Intelligence of systems and subsystems has provided Defence with a capability for quantitative understanding of weapon systems performance.

Integrated air and missile defence: Integrated tactical-level modelling, simulation and analysis (MS&A) allow Defence capabilities to identify the application, and performance, of tactical systems that support joint warfighting doctrine and increase mission success.

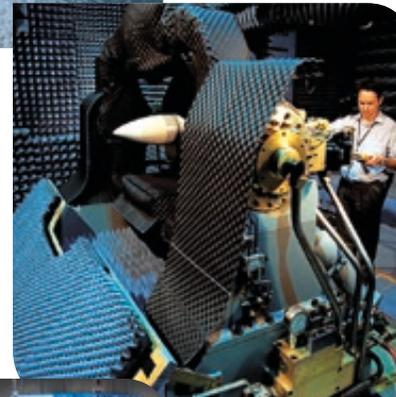
Land active protection systems: Support to Future Force through constructive modelling and simulation of active protection system concepts enabling the evaluation and integration of future technologies.

Capability enhancement: Identifying and influencing the mission system decision logic to maximise the current capability.

Future proofing: Use of MS&A of large scale (many versus many) complex engagements to inform future capability needs.



WEAPONS SYSTEMS
EVALUATION



TACTICAL SYSTEMS
MODELLING AND
SIMULATION



TACTICAL SYSTEMS
ASSESSMENT

S&T excellence

THREE YEAR PUBLICATION RECORD

- 10 DST technical reports
- 44 DST client reports
- 8 DST technical notes
- 3 DST general document
- 1 DST discussion paper
- 8 Conference papers
- 2 Journal papers

PEER RECOGNITION

- 2 ARC examiners
- 3 journal reviewers
- 6 Society memberships
- TTCP WPN Group TP8 National Lead

AWARDS

- TTCP Award 2017
- Australian Intelligence Community Award 2016
- DST Achievement Award 2016
- DST Achievement Award Finalist 2017
- 2 x CDS Gold Commendations 2016
- Chief of Airforce Gold Commendation Award 2016
- SA Early Career STEM Professional Award 2015

Partnerships and outreach

UNIVERSITIES

- The University of Adelaide
- The University of Melbourne
- ACEMS (Australian Research Council Centre of Excellence for Mathematical and Statistical Frontiers)

INDUSTRY

- Consilium
- Saab Australia
- Shoal
- Kongsberg
- MathWorks

INTERNATIONAL

- TTCP Weapon Group
- Dstl, MBDA (UK)
- TNO (Netherlands)
- NATO STO
- DRDC (Canada)
- Intelligence Community (Five Eyes)
- NAVSEA, AFRL (US)
- NASA (US)

S&T capabilities

WEAPONS SYSTEMS EVALUATION

The **Weapons Systems Evaluation** group conducts software and hardware experiments on weapons and their subsystems to deliver advice on weapon performance. Future weapon concepts are conceived, designed and evaluated to assess performance and it informs subsystem requirements.

TACTICAL SYSTEMS MODELLING AND SIMULATION

The **Tactical Systems Modelling and Simulation** group leads the modelling, simulation and analysis of the software-controlled decision making systems within the tactical engagement chain – Joint, Maritime, Air and Land combat management systems – and researches simulation services within dynamic combat networks.

TACTICAL SYSTEMS ASSESSMENT

The **Tactical Systems Assessment** group leads the performance analysis of complex, contested tactical engagement by: defining the analysis context, scope and objectives; composing and exercising integrated modelling and simulation-based solutions to enable analysis; and shaping the approaches used through its research into complex systems analysis methodologies.

World-class capabilities and infrastructure



MISSILE SIMULATION CENTRE

The Missile Simulation Centre and Combat System Integration Laboratory are world-class facilities and represent a sovereign capability that would be difficult to reconstitute.



Weapon Systems Technologies

Goal

Strengthen ADF warfighting capability by applying the S&T of tactical perception, assured delivery of effects and electromagnetic interactions to weapons and combat systems.

Impact

Shaping Future Force weapons and combat capability: Investing S&T into emerging and disruptive technologies including directed energy weapons, collaborative and swarming weapons, and high-speed systems. The research is contributing to important programs and capabilities such as Land 400 and Integrated Air and Missile Defence.

Support to operations: Accurate target location error analysis has been undertaken for RAAF precision guided weapons enabling F/A-18A integration with coalition forces. Conduct of Trial Griffin Fury and support of Air Warfare Centre live fires program. Electromagnetic studies have ensured safe and non-degraded operation of JDAM-ER, ASRAAM and Radio Frequency systems being procured under projects AIR 6000, SEA 1448, AIR 7000 and SEA 4000.

Driving defence innovation: Partners in three successful DST Competitive Evaluation Research proposals, six Counter Improvised Threat Grand Challenge projects, one successful Trusted Autonomous Systems Defence CRC submission, and three funded Defence Innovation Hub projects. Leading Single Photon Avalanche Diodes technologies and Quantum sensing projects.



S&T excellence

THREE YEAR PUBLICATION RECORD

- 48 DST technical reports
- 25 DST client reports
- 26 Journal publications
- 15 Conference papers
- 5 Patents

PEER RECOGNITION

- ARC Reviewer
- Adjunct Professor
- 4 PhD Examiners
- 5 Journal Reviewers
- Chair TTCP WPN Group
- 3 Intl. Conference Committee Members

AWARDS

- 2 MBDA (UK) Innovation Awards 2013, 2015
- UK MOD CSA Commendation 2014
- TTCP Award 2014
- 2 DST Achievement Awards 2015
- 2 Chief of Air Force Commendations 2016
- 2 Civilian Operation Service medals 2013, 2015
- Australia Day Medallion 2016, 2017
- DST Award for Outstanding Communication of S&T 2016
- CDS Gold Commendation 2015
- TTCP Award 2017
- John Monash Scholarship 2017

Partnerships and outreach

UNIVERSITIES

- University of Adelaide
- University of Western Sydney
- University of NSW
- Monash University
- RMIT
- Australian National University
- Deakin University

INDUSTRY

- Fraunhofer IZM
- BAE Systems
- Teledyne Defence Australia

GOVERNMENT

- ANSTO
- Government of South Australia

INTERNATIONAL

- TTCP WPN Group
- NAVAIR, AFRL, AFSEO (US)
- DRDC (Canada)
- MoD E3, Dstl (UK)
- BAE Systems, MBDA (UK)
- Air Warfare Centre (UK)
- Kongsberg (Norway)
- Milan Politechnic (Italy)
- Japan Atomic Energy Agency (Japan)
- FSTD (Singapore)

S&T capabilities

WEAPON SEEKERS AND TACTICAL SENSORS

The **Weapon Seekers and Tactical Sensors** group undertakes research in novel sensor technologies for weapons and tactical sensors to support advanced seeking, detection, tracking and navigation in complex, hostile and contested battlespaces.

SENSOR PROCESSING AND ALGORITHMS

The **Sensor Processing and Algorithms** group develops and evaluates advanced algorithms for sensing and perception to enhance battlefield situational awareness and targeting.

COLLABORATIVE WEAPONS AND AUTONOMOUS RESPONSE

The **Collaborative Weapons and Autonomous Response** group undertakes research in trusted autonomous decision making in weapons under uncertainty, and effective delivery of effectors to neutralise threats with precision and low collateral damage.

ELECTROMAGNETIC EFFECTS CHARACTERISATION AND CONTROL

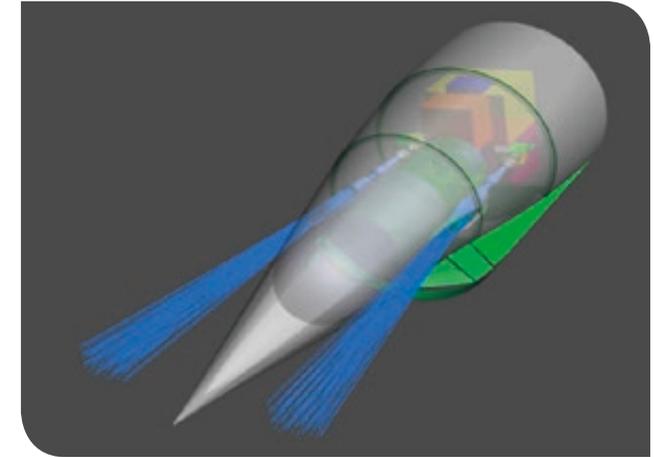
The **Electromagnetic Effects Characterisation and Control** group undertakes research and delivers S&T advice on complex electromagnetic (EM) interactions, high power microwave weapons, and protection measures for ADF systems operating in congested EM environments.

World-class capabilities and infrastructure



SCENE GENERATION CAPABILITIES

VIRSuite is a real-time electro-optic/infrared scene generation capability that has been commercialised and distributed to DST's Five Eye partners. ARES is a world-class five channel radio frequency (RF) scene generator that enables hardware in the loop simulation of 5th generation RF missiles.



Energetic Systems and Effects

Goal

To safely sustain and enhance the operational effectiveness of energetic systems for ADF weapon systems, and to conduct research to shape and enable future capabilities for energetic systems and high Mach number sciences.

Impact

Enabling future capabilities: Strategic research and development of advanced high speed flight, boost and propulsion systems is critical to enable Defence to meet challenges in an emerging technology environment. Research and development of explosives and warhead technologies in collaboration with international partners is enabling game-changing Defence capabilities.

Countering current and emerging threats: As Australia's primary source of expertise in energetic systems (including warheads, IEDs and counter-measure flares), the MSTC is responsive to time critical Defence and national security requirements.

Operational and intelligence advice: Research and analysis to Defence and Intelligence agencies enables informed understanding of explosive ordnance capabilities and mitigation strategies to protect the ADF from current and evolving threats.

Safe and effective explosive ordnance: DST knowledge and research is ensuring the safety and effectiveness of frontline ADF weapon systems and has saved Defence over \$50M in acquisitions and averted fatal risks to personnel.



EXPLOSIVES AND
PYROTECHNICS



WEAPONS
PROPULSION



HIGH SPEED
SYSTEMS

WARHEADS
AND EFFECTS

S&T excellence

THREE YEAR PUBLICATION RECORD

- 28 DST technical reports
- 30 DST client reports
- 11 Journal publications
- 2 Book chapters
- 7 Patents
- 47 Conference papers
- 66 HIFire reports

PEER RECOGNITION

- 4 Adjunct Professor/Lecturer Positions
- 3 PhD Supervisors
- 6 Journal Reviewers
- Fellow Royal Australian Chemical Institute
- Memberships of AIAA, Engineers Australia, American Chemical Society, Royal Society of Chemistry and International Pyrotechnics Society
- 1 Chartered Professional Engineer

AWARDS

- CDS Gold Commendation 2015
- CTTSO 10 Years Outstanding Service 2016
- TTCP Awards 2016 & 2017
- Chief Air Force Gold Commendation 2016
- AFP Commissioner Award 2016
- DST Achievement Award in Technical Excellence and Outstanding Corporate Contribution 2016
- Australia Day Medallion 2016

Partnerships and outreach

UNIVERSITIES

- Flinders University
- RMIT
- University of NSW Canberra
- University of Queensland
- University of South Australia
- University of Southern Queensland
- University of Wollongong

INDUSTRY

- BAES
- Ballistic Systems
- Chemring Australia
- DefendTex
- Gilmour Space Technologies
- DMTC
- Thales Australia

GOVERNMENT

- AFP
- Attorney General's Department
- Defence Export Controls (MTCR)
- Queensland Government

INTERNATIONAL

- AFRL (US)
- ARDEC (US)
- CTTSO (US)
- Dstl (UK)
- TTCP WPN Group
- University of Manchester (UK)
- MBDA (UK)
- Defence Ordnance Safety Group (UK)
- Boeing (US)
- Go Hypersonic (US)
- German Aerospace Centre (DLR)
- Lockheed Martin (US)

S&T capabilities

EXPLOSIVES AND PYROTECHNICS

The **Explosives and Pyrotechnics** group undertakes research into current and future military and home-made explosives, pyrotechnics, as well as explosive ordnance and devices containing energetic materials.

WARHEADS AND EFFECTS

The **Warheads and Effects** group conducts research into high-performance warhead concepts and non-traditional explosive devices to understand, model, and exploit terminal effectiveness.

WEAPONS PROPULSION

The **Weapons Propulsion** group undertakes research into advanced weapon propulsion technologies including the safety and reliability of current and emerging ADF weapon propulsion systems.

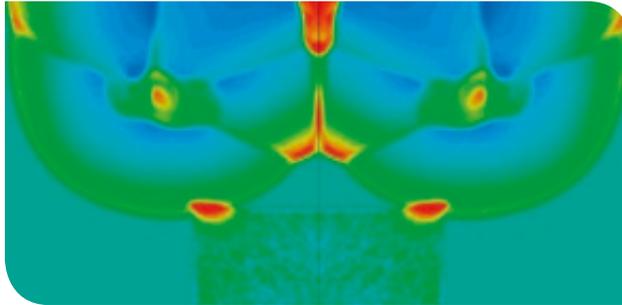
HIGH SPEED SYSTEMS

The **High Speed Systems** group undertakes research into high Mach number science – focusing on scramjet propulsion – and provides a capability to execute high Mach number flight test trials, including the design and production of experimental high speed flight test vehicle.

ENERGETIC SYSTEMS CAPABILITIES

Research of the **Energetic Systems and Effects** branch is enabled by extensive fabrication and characterisation facilities, as well as an explosive ordnance management capability that supports the safety and assurance of explosive ordnance across DST.

World-class capabilities and infrastructure



BLAST MODELLING

High explosive experiments probed with detailed diagnostics such as flash x-ray, high speed video, and an array of sensors support the development of predictive warhead effects modelling that guides a broad range of weapon acquisition and future capability decisions.



ROCKET MOTOR TEST

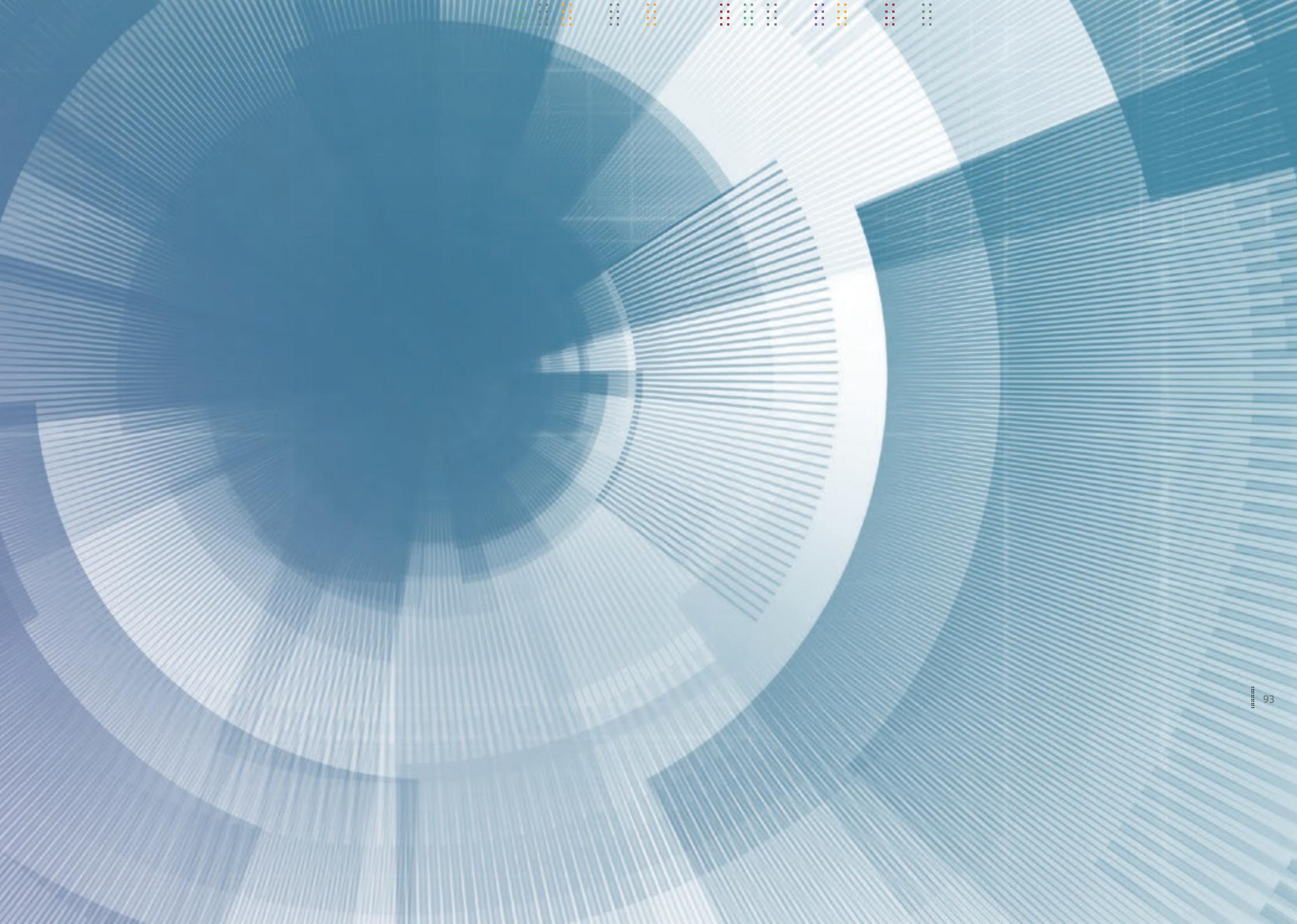
The rocket test facilities located at RAAF Edinburgh and Woomera are the most significant in Australia. Staff expertise and specialist infrastructure, including DST's real-time data acquisition and control system, affords a unique capability that enables Defence research and client programs often with international partners.

ENERGETIC SYSTEMS AND EFFECTS RESEARCH CAPABILITIES

Warhead performance characterisation, pyrotechnics research and service life assessment of munitions, including rocket motors has been externally assessed as world-class. Facilities and advanced diagnostic systems to support this research are also considered world-class.







Abbreviations and acronyms

ABCANZ	America, Britain, Canada, Australia, New Zealand information exchange MOU
ADD-ROK	Agency of Defence Development
ADF	Australian Defence Force
AEPM	Aerospace Equipment Program Management
AFP	Australian Federal Police
AFRL	Air Force Research Laboratory
AFSEO	Air Force SEEK EAGLE Office
AIAA	American Institute of Aeronautics and Astronautics
AMRDEC	Aviation and Missile Research Development and Engineering Center
ANSTO	Australian Nuclear Science and Technology Organisation
ANZSMS	Australian and New Zealand Society for Mass Spectrometry
ARC	Australian Research Council
ARDEC	Armament Research, Development and Engineering Centre
ARL	Army Research Laboratory
ASC	Australian Submarine Corporation
ASD	Australian Signals Directorate
ASE	Aerospace Electrical Systems
ASW	Anti-Submarine Warfare
ATLA	Acquisition, Technology and Logistic Agency
ATSB	Australian Transport Safety Bureau
BAE Systems	British Aerospace Systems
C2ISR	Command and Control, Intelligence, Surveillance and Reconnaissance
CASA	Civil Aviation Safety Authority
CBRN	Chemical, Biological, Radiological, Nuclear
CDS	Chief Defence Scientists
CERDEC	Communication-Electronics, Research Development and Engineering Center
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTE	Common Test Environment
CTTSO	Combating Terrorism Technical Support Office
DARPA	Defense Advanced Research Projects Agency
DIF	Defence International Fellowship
DLR	German Aerospace Centre
DMTC	Defence Materials Technology Centre

DORS Defence Operations Research Symposium
 DRDC Defence Research and Development Canada
 DSF Defence Science Fellowship
 Dstl Defence Science and Technology Laboratory
 DSTA Defence Science and Technology Agency
 DTA Defence Technology Agency
 EW Electronic warfare
 FSTD Future Systems and Technology Directorate
 GPS Global positioning system
 HQJOC Headquarters Joint Operations Command
 IED Improvised Explosive Device
 IEEE Institute of Electrical and Electronics Engineers
 ISO International Standards Organisation
 ISR Intelligence, Surveillance and Reconnaissance
 JDAM The Joint Direct Attack Munition
 JORN Jindalee Operational Radar Network
 JSF Joint Strike Fighter
 LIF Loading Instruction Form
 LMLC Low Mobility Load Carrier
 MARIN Maritime Research Institute
 MBDA European developer and manufacturer of missiles
 MCM Mine Countermeasure
 MELCO Mitsubishi Electric Corporation
 MILSATCOM Military Satellite Communications
 MIT Massachusetts Institute of Technology
 MOD Ministry of Defence
 MORS Military Operations Research Society
 MOU Memorandum of Understanding
 MSSANZ Modelling and Simulation Society of Australia and New Zealand
 MSTC Major Science and Technology Capability
 NACC New Air Combat Capability
 NASA National Aeronautics and Space Administration
 NATO North Atlantic Treaty Organisation

NATO STO NATO Science and Technology Organisation, within which there are the following panels:
 AVT Applied Vehicle Technology
 HFM Human Factors and Medicine
 IST Information Systems Technology
 SAS Systems Analysis and Studies
 SCI Systems Concepts and Integration
 SET Sensors and Electronics Technology
 MSG NATO Modelling and Simulation Group
 NAVAIR Naval Air Systems Command
 NAVSEA Naval Sea Systems Command
 NRC National Research Council
 NRL Naval Research Laboratory
 NSRDEC Natick Soldier Research, Development and Engineering Center
 NSWC Naval Surface Warfare Centre
 NUWC Naval Undersea Warfare Centre
 ONR Office of Naval Research
 PEOSUBS Program Executive Office, Submarines
 R&D Research and Development
 RAAF Royal Australian Air Force
 RAN Royal Australian Navy
 RCAF Royal Canadian Air Force
 RF Radio frequency
 RMIT Royal Melbourne Institute of Technology
 S&T Science and Technology
 SATCOM Satellite Communications
 SP&I Defence Strategic Policy and Intelligence Group
 SRI Strategic Research Initiative
 STEM Science, Technology, Engineering and Mathematics education program
 SIGINT Signals Intelligence
 SPAWAR Space and Naval Warfare Systems Command
 SPIE International Society for Optics and Photonics
 TARDEC Tank Automotive Research, Development and Engineering Center
 TNO Netherlands Organisation for Applied Scientific Research

TTCP The Technical Cooperation Program, within which are the following 10 Groups:
 AER Aerospace Systems Group
 C3I Command, Control, Communications and Information Systems Group
 EWS Electronic Warfare Systems Group
 HUM Human Resources and Performance Group
 ISTAR Intelligence, Surveillance, Target Acquisition and Reconnaissance Group
 JSA Joint Systems and Analysis Group
 LND Land Systems Group
 MAR Maritime Systems Group
 MAT Materials and Processing Technology Group
 WPN Conventional Weapons Technology Group
 USAF US Air Force
 US DHS United States Department of Homeland Security
 USN US Navy
 WTD 52 Bundeswehr Technical Center for Protective and Special Technologies

PROJECTS

AIR 6000 New Air Combat Capability
 AIR 7000 Maritime Patrol Aircraft Replacement
 AIR 9000 Future Naval Aviation Combat System
 LAND 121 Land Vehicles Modernisation
 LAND 400 Mounted Close Combat Capability
 SEA 1000 Future Submarine
 SEA 1180 Offshore Patrol Vessel
 SEA 1397 Nulka Anti-Ship Missile Defence System Update
 SEA 1448 Anzac Ship Anti-Ship Missile Defence
 SEA 1770 Maritime Rapid Environmental Assessment
 SEA 1778 Deployable Mine Counter Measures
 SEA 3033 Commercial Vessel ADV Ocean Protector
 SEA 4000 Air Warfare Destroyer
 SEA 5000 Future Frigate



Australian Government

Department of Defence

Science and Technology

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CCEWD@dst.defence.gov.au

Chief Weapons and Combat Systems Division

Phone: +61 8 7389 6091
CWCS@dst.defence.gov.au

For further information on DST

Visit: www.dst.defence.gov.au



DST

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Defence values diversity