DEFENCE AND SECURITY SYMPOSIUM

'Defence and Industry Sovereign Capabilities for the Defence and Security of Australia'

Deakin Downtown (Melbourne), Level 12, Tower 2, 727 Collins Street, Melbourne, Victoria 3008
and virtual over Zoom (AEDT)

Date: 1 December 2022

The Defence and Security Symposium (DSS) is an annual event which brings together participants from Defence, industry and academia to exchange ideas and information and to connect with decision-makers from Defence, academic researchers and industry capability developers.
This symposium aims to bring together subject matter experts from government, industry, and academia to discuss the development of Defence and Industry Sovereign Capability for the Defence and Security of Australia. Some of the key capabilities identified include:

- Robotics, Autonomous Systems and Artificial Intelligence
- Power and Energy/Green Hydrogen
- Information Warfare and Cyber Capabilities
- Advanced Materials and Manufacturing
- Advanced and Networked Sensing
- Health, Nutrition and Technology Driven Training
- Quantum Technology for Sensing and Imaging, Communication and Cryptography and Computing and Simulation
- Space Technologies

This is an invitation to academics, defence research institutions, commercial organisations, and the military to attend and/or offer papers in the field of developing Australia's Defence and Industry Sovereign capability and associated disciplines.

Symposium Program

9:30 – 10:00 **Registration & Coffee**

10:00 – 10:05 **Symposium Opening-Introduction**
Symposium Chair: Pro Vice-Chancellor Defence, Deakin University
Alfred Deakin Professor Saeid Nahavandi

10:05– 10:20 **Symposium Opening**
John (Johnno) O'Callaghan, BA, Cert Mgt, Victorian Defence Industry Advocate and the Chair of the Defence Council Victoria

John (Johnno) O'Callaghan is the Chair of the Defence Council Victoria and Defence Science Institute Advisory Board. He has over 30 years' experience in senior public and private sector roles. In 2019, he was appointed as the Victorian Defence Industry Advocate. In this role he provides strategic defence industry advice to the Victorian Government, as well as assisting Victorian based defence industry companies to navigate, among other things, the complex Department of Defence procurement process.
For five years until 2017, Johnno was Executive Director of the Australian Industry Group Defence Council, the leading organisation representing the interests of defence industry made up of the CEOs of Australia's defence industry companies. He chaired the Defence Council's Contracting Working Group focused on improving defence capital procurement with attention to intellectual property, liability, insurance and reducing red tape.
Prior to this, Johnno was the Government Relations Manager for Virgin Blue (now Virgin Australia) and the Corporate Affairs Manager at Bonlac Foods (now Fonterra).
Johnno's extensive public sector roles have included as Assistant Secretary, Major Capital Procurement in the Department of Defence; Senior Adviser to former Deputy Prime Minister and Minister for Defence, the Hon Kim Beazley AC; and Senior Parliamentary Adviser to Kim Beazley's Leader of the House of Representatives role.
His academic qualifications include a Bachelor of Arts from Australian National University and a Certificate of Management from Canberra TAFE.

Program Chair: Professor Vinod Puri, Deakin University

10:20 – 10:35 Interaction-Centered Design: Quenching the Thirst for Effective Human-AI/Autonomy Teaming Guidance

Dr. Ming Hou, Senior Defence Scientist, Principal Authority Human-Technology Interaction - Defence Research and Development Canada

The effective human-autonomy teaming is challenged by the lack of understanding of human-machine interaction issues and appropriate design methodologies for mission/safety-critical systems. Limitations and strengths of human and artificial intelligence (AI) must be well understood first before designing, developing, and employing AI-enabled human-machine systems. It is not only about the safety of these systems, but more importantly human lives and mission success. A systematic and structured approach for design, develop, verify, validate, and regulate disruptive technologies is critical to the entire life cycle of these emerging systems. This talk reviews the evolution of design strategy of intelligent systems, presents the state-of-the-art design methodologies to address the interaction challenges for effective human-autonomy teaming. A technological solution of effective human-AI teaming for decision-making in weapon engagement provides a best practice example for systems designers, developers, project manager, researchers, and all practitioners who are interested in building and using 21st century human-AI symbiosis technologies.

Dr. Ming Hou *received his Ph. D in Human Factors Engineering from the University of Toronto, Canada in 2002. Currently, he is a Senior Defence Scientist and the Principal Authority in Human-Technology Interactions within the Department of National Defence (DND) Canada, an Integrator of the Canadian $1.6B Innovation for Defence Excellence and Security (IDEaS) program, and the Co-Chair of NATO Human Factors Specialist Committee for Joint Capability Group Unmanned Aircraft Systems. Dr. Hou is responsible for delivering innovative technological solutions, science-based advice, and evidence-based policy recommendations to senior decision makers within DND and the Canadian Armed Forces (CAF), and their national and international partner organizations. He was a Scientific Advisor to the Canadian National Centre of Expertise on Human Systems Performance (HSP) and the Canadian National Leader of HSP Joint Panel – Air within The Technical Cooperation Program (TTCP) and led the Canadian efforts in the TTCP Autonomy Strategic Challenge Joint Exercise "Autonomous Warriors 2018" in Australia. As the Principal Scientist, Dr. Hou led the DND/CAF capability development projects including the 1st Canadian Intelligent Tutoring System for Counter Improvised Explosive Device Operator Training, the 1st Command and Control Centre for the $6B Canadian major capital acquisition project Remotely Piloted Aircraft System, and the 1st Human-AI Symbiosis Technology for Weapon Engagement. His influential book: "Intelligent Adaptive Systems: An Interaction-Centered Design Perspective" has guided the development of NATO STANRECs on "Human Systems Integration Guidance for UAS" (4685) and "Sense and Avoid Guidance for UAS" (4811). He delivered the invited NATO Lecture Series on "UAVs: Technological Challenges, Concepts of Operations, and Regulatory Issues" from 2017 to 2019. Dr. Hou is the recipient of the prestigious DND Science and Technology Excellence Award in 2020 and the President's Achievement Award of the Professional Institute of the Public Service of Canada in 2021. He has also been nominated to the Engineering Alumni Hall of Distinction at the University of Toronto and the IEEE Systems, Man, and Cybernetics Society Outstanding Service To Humanity Award in 2022. Dr. Hou is a Fellow of the International Institute of Cognitive Informatics and Cognitive Computing.*

10:35 – 10:50 The Role of Modelling and Simulation in Developing Sovereign Capabilities for Defence

Philip Swadling, Technical Director, Avionics, Thales Australia

Simulation, and modelling is a fundamental capability enabler and force multiplier for defence, well beyond its use in individual and collective training. Although simulation is already regularly applied other areas, such as force design and exploration of capability option, it does not have the profile needed to ensure there are sufficient people with the right skills and experience to do this work in Australia. In today's increasing complex world, modelling and simulation must be seen an essential element of the entire capability life cycle. This is especially true when robotics and autonomous systems are concerned. This presentation highlight the critical nature of the role modelling and simulation plays in capability development and discuss the key issues needing to be addressed to ensure a sovereign modelling and simulation capability. It will also make the case for including modelling and simulation as a Sovereign Industry Capability Priority for Defence.

Philip Swadling *is the Technical Director for Avionics with Thales Australia and Chair of the Board of Simulation Australasia. He has over thirty years' experience in engineering for defence systems, with the majority of that time spent in simulation and aerospace projects. In his role with Thales, Philip is responsible for technical strategy, design oversight and research and development topics both locally and globally. Philip holds a B.E in Electrical Engineering and a B.Sc. in Computer Science is a Chartered Engineer, member of Engineers Australia and a Senior Member of the Institute of Electrical and Electronics Engineers (IEEE). He is a member of the Thales Australia Diversity and Inclusion Council and Reconciliation Action Group and an enthusiastic mentor and supporter of prospective and early career engineers.*

10:50 – 11:05 Innovation to Drive Sustainable Transport Infrastructure

Dr. Clarissa Han, National Leader / Chief Technology Leader, Sustainability and Materials Performance, National Transport Research Organisation

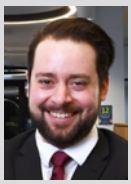
ARRB/NTRO is the Australian thought leader in the field of innovative materials research and infrastructure sustainability. The presentation will cover some ARRB's recent research on the use of upcycled, recycled and sustainable materials in various applications of roads and transport infrastructure. Some case studies will be discussed to illustrate the lifecycle sustainability impacts of using these recycled materials.

Dr Clarissa Han *is the National Leader of the ARRB/NTRO Sustainability and Materials Performance Business Group. Clarissa has 25 years' of engineering and research experience in transport management and operations, network sustainability and resilience and emerging ITS technologies. Clarissa has been a major contributor to various national guidelines, standards and specifications in transport operations. She is the current Australian member of the PIARC Mobility Strategic Theme TC2.4 Road Network Operations/ITS. She has been elected as the board member of the International Road Federation (IRF) since 2021.*

11:05 – 11:20 Aircraft Or Spacecraft? How Compact Space-based EOIR Will Rival Traditional ISR Architectures

George Coulloupas, Business Development Manager – Space, Leonardo Australia Pty Ltd.

Timely, credible and trusted intelligence is a cornerstone for any national strategy, military operation, policy and public development, and the commercial space industry has accelerated the application of affordable space-derived products and services in high-end warfighting, maritime surveillance and navigation. As part of Europe's COVID recovery strategy, Space Economy funding from Italy is realising a new suite of state-of-the-art compact electro-optical payloads for small space platforms. At Leonardo, developments are underway on Earth Observing payloads for a constellation of satellites known as "IRIDE / IRIS " featuring Compact Hyperspectral, Very High Resolution and Thermal Infra-Red payloads to be flown in 2026. This presentation will discuss the technology, and demonstrate its' applications with current aerial surveillance practices to explore how this can complement Australia's approach towards broad-area civil maritime surveillance.



George Coulloupas *leads Leonardo Australia's Business Development for the company's Divisional Space Business products, COMSO-SkyMed imagery for defence and government and supports the company's space program in partnership with SmartSat CRC and the Space Trailblazer consortium with the Australian National University and University of Southern Queensland. Before joining the company, George founded space start-ups exploiting commercial Earth Observation data while also supporting the RAAF M2 mission at UNSW investigating charged aerodynamics forces of objects in LEO spaceflight for his PhD thesis. George brought with him to Leonardo collaborative R&D experience and commercial insights to the global top 10 Defence and Aerospace prime as it grows a presence in the Australian defence and space ecosystem, headquartered regionally in Fisherman's Bend.*

11:20 – 11:35 The Story of the Wombat and the Kelpie" – Australian Sovereign Capability in Land EW

Dr. Andrew Lucas, Managing Director - AOS Group

The Army on the move requires a sophisticated EW capability, both passive and active, for it to operate effectively. Australia's Army is highly mobile and capable, but small in size. The challenge is to make every soldier is productive as possible, handing off repetitive, time-consuming, or dangerous tasks to autonomous systems.
Electronic warfare is one example of where autonomous systems can complement the soldiers on the ground.
Historically EW equipment has been bulky and expensive, either housed in fixed locations, such as a deployed HQ, or more recently under LAND555 as equipment installed in some Bushmasters. The Bushmaster-based EW capability requires a crew of two or three in a high-value vehicle.
Agent Oriented Software and Asension have combined their complementary capabilities to produce an autonomous EW capability: HERCULES EW.
HERCULES EW is a game changer, offering a distributed, resilient EW capability. HERCULES EW is based on a number of small autonomous ground vehicles, and potentially small UAVs, that work together as a team. Each vehicle mounts a small, low-cost EW transceiver, the Wombat, and they work together to provide a highly effective, distributed EW capability. The system is embedded within the ground force, providing dismounted soldiers with organic EW protection and electronic attack capability.
The system builds upon the HERCULES MANET resilience system demonstrated to Army in 2021. Its advantages include:

- Sovereign EW capability designed for Australian Army needs.
- Low-cost distributed EW capability.
- Resilient communications mesh network.
- Spectrum monitoring for channel assurance and allocation
- Network awareness provided by RF spectrum monitoring.

- Ultra-wideband radar for detection of concealed threats.
- High-power illuminator for bistatic operations.
- Cognitive tools for pre-emptive Electronic Attack.

Andrew Lucas *is the founder and Managing Director of Agent Oriented Software (AOS), established in Melbourne in 1997 as an offshoot from the Australian Artificial Intelligence Institute (affiliated with the AI Center at SRI International, Menlo Park, CA). AOS specialises in AI, and autonomous and robotic systems – working on autonomous systems with UK Ministry of Defence, RAAF, Australian Army, RAN, CASG, and DST Group.*

AOS has developed its own technology base of AI software, focused on intelligent software agents, combining this with other AI technologies, including machine learning, machine vision, and constraint programming. Andrew leads AOS's development of autonomous vehicle technology, including teams of autonomous vehicles for the defence, agricultural, mining and construction industries.

Andrew holds a Ph.D. in Aeronautical Engineering from Cambridge University and a Bachelor of Engineering (1st Hons) from the University of Melbourne. Andrew is a member of the Royal Aeronautical Society's Remotely Piloted and Autonomous Aircraft Systems Specialist Group.

11:35 – 11:50 A Breakthrough Theory and Algorithm for Solving Nonlinear Knapsack Problems with Applications in Air Defence

Professor David Yang Gao, Deakin University

Knapsack problems appear extensively in decision science, military logistics, systems engineering, optimal design and control. Due to the integer constraint, even the simplest linear Knapsack problem has been listed as one of Karp's well-known 21 NP-complete problems.

Canonical duality is a breakthrough methodological theory, which can be used not only for modelling complicated phenomena within a unified framework, but also for solving a wide class of nonconvex/nonsmooth/discrete problems in multidisciplinary fields [1,2,3,4]. The associated triality theory reveals an interesting multi-scale duality pattern in complex systems, it can be used to identify both global and local extrema and to design powerful algorithms for solving challenging problems. In this talk, the speaker will show that by using this theory, general Knapsack problems can be converted into a convex minimization problem in continuous space, which can be solved deterministically in polynomial time. Analytical solutions will be presented for both linear and quadratic knapsack problems. Applications will be illustrated by bi-level topology optimization of lightweight aircraft design and incoming missile defence.

This talk should bring some fundamental new insights into computational science, mathematics, and global optimization.

[1] Gao, D.Y. (2000). Duality Principles in Nonconvex Systems: Theory, Methods and Applications. Springer, 2000, xviii+454pp.
[2] Gao, D.Y., Ruan, N., Latorre, V. (2017). Canonical Duality-Triality: Unified Theory for Multidisciplinary Sciences, Springer.
[3] Gao, D.Y. (2019). Canonical Duality-Triality Theory: Unified Understanding for Modeling, Problems, and NP-Hardness in Global Optimization of Multi-Scale Systems, in Advances in Mathematical Methods and High Performance Computing, V. K. Singh et al. (eds.), Springer, pp 3-50.
[4] Gao, D.Y. (2021). Canonical Duality Theory and Algorithm for Solving Bilevel Knapsack Problems With Applications, Volume: 51, Issue: 2, Page(s): 893 – 904.

Professor David Y. Gao *received his Ph.D. in Engineering Mechanics and Applied Math from Tsinghua University. He has held research and teaching positions in different institutes including MIT, Yale, Harvard, University of Michigan and Virginia Tech. He moved to Australia in 2010 for the Alexander Rubinov Professor of Mathematics at Federation University Australia. Currently, he is an honorary professor at Deakin University.*

Professor Gao is the author of 17 monograph/handbook/special volumes and about 200 research papers (> 50% are single authored) on applied mathematics, theoretical and computational mechanics, operations research, global optimization and control etc. His main research contributions include a canonical duality-triality theory, several mathematical models in engineering physics and material science, a series of complete solutions to a class of nonconvex/nonsmooth/discrete problems in natural sciences, and some deterministic methods/algorithms for solving certain NP-hard problems in global optimization and computational science.

Professor Gao's multidisciplinary research has been supported by different programs at US National Science Foundation (NSF) and US Air Force Office for Scientific Research (AFOSR) before he moved to Australia in 2010. Professor Gao's canonical duality-triality theory has been identified by AFOSR as breakthrough research and his team has been continuously receiving research grants from the AFOSR Washington Office since 2010.

Professor Gao is an editor-in-chief for Springer book series Advances in Mechanics and Mathematics and Taylor & Francis book series Modern Mechanics and Mathematics. He is also an associate editor for several international journals. Since 2000, Professor Gao has delivered over 40 keynote/plenary/invited lectures at international conferences and more than 60 colloquium talks at different universities and institutions. As a chair and co-chair, he has organized successfully about 10 world congress/conferences. Currently, he is serving as a Vice President of the International Society of Global Optimization.

11:50 – 12:05 The Assurance Challenge of RAS-AI Systems

Kevin Robinson, Chief Technology Officer, Dedicated Systems Australia

Autonomous systems rely on software to deliver the desired behaviour and performance, including safety. Historically, techniques such as control theory, implemented through physics-based algorithms, have controlled these systems. This physics-based approach has enabled those undertaking safety assurance to understand the evidence presented in a safety case. With the advent of Artificial Intelligence, specifically, Machine Learning, being employed to control autonomous systems, understanding the underlying physics-based principles is becoming challenging.
The presentation explores the challenges and opportunities for modelling and simulation to provide the evidence for a safety case of a machine learning enabled autonomous system.

Kevin Robinson *is the Chief Technology Officer with Dedicated Systems Australia and oversees the development of systems and capabilities for external clients. Kevin spent his early career researching and developing guided weapons in the UK's Ministry of Defence and Australia's Department of Defence. After leading larger research teams and delivering outcomes to Defence across guided weapons and tactical communication systems, he moved to industry, where he became Chief Engineer and was accountable for the effective application of innovation and engineering by the 80+ engineers.*

12:05 – 13:00 Lunch and poster presentations session 1
Session Chair: Adjunct Professor (Brigadier rtd) David McKaskill

13:00 – 13:15 Disruptive Defence Innovation, A Trusted Autonomous System Perspective
Dr Simon Ng, Chief Engineer, Trusted Autonomous Systems Defence CRC

Innovation underpins current Western military advantage and the desire of Defence organisations to gain and maintain a decisive edge. Revolutions in military affairs rely on innovation, whether in technology, process or practice (doctrine), and much effort has been spent on understanding the source of and promoting innovation in public and private institutions. Defence innovation is "the transformation of ideas and knowledge into new or improved products, processes and services for military and dual-use applications." [Tai 2021]. It occurs within a broader innovation system of catalysts, networks, organisations and policies, and can be broadly categorised as incremental or disruptive [Christenson 2015], with both forms of innovation critical to an effective Defence capability. [Gans 2016] highlights the dilemma at the heart of innovation: organisations that are effective at incremental innovation are often ineffective at disruptive innovation, for obvious reasons related to business models and market forces. Defence established the Trusted Autonomous Systems (TAS) Defence CRC to foster innovation in the emerging technology domain of autonomy, and through this to create impact for Defence. TAS provides a compelling example of an organisation that can support disruptive innovation. Through its policies, practices, structure, networks and skills, it has the capacity to act as a catalyst for disruptive innovation. This talk will provide insight into how TAS has approached disruptive innovation and the impact that TAS is managing to have, using specific examples from TAS portfolio. It will also address the pitfalls of acting as a disruptor, and provide suggestions for other organisations to consider as they better improve their approach to innovation.
Gans, Joshua (2016) *The Disruption Dilemma*, MIT Press.
Christensen, Hayden (2015) *The Innovator's Dilemma*, Harvard Business Review Press.
Tai Ming Cheung (2021) A conceptual framework of defence innovation, *Journal of Strategic Studies*, 44:6, 775-801.

Dr Simon Ng *is Chief Engineer at TAS. Graduating from Monash University with a PhD in 1998, he completed a Post-Doctoral Fellowship at CSIRO before joining DSTG, where he developed techniques for military operations experimentation, and applied systems methods to surveillance and response, space operations and autonomous aerial systems. He was previously DSTG Group Leader for the Joint Systems Analysis and Aerial Autonomous Systems Groups, and Associate Director of the Defence Science Institute and Adjunct Associate Professor at the University of Melbourne. He has served as Australia's National Lead on The Technical Cooperation Program Technical Panel "Joint Systems Integration" and "UAS Integration into the Battlespace", and is a Graduate of the Australian Institute of Company Directors.*

13:15 – 13:30 The human element of space missions
Michael Hardy, Director, Innovation & Technology, KBR

In this presentation, Michael Hardy, from KBR, will explore 'How do we prepare and sustain humans on space missions?' Drawing on KBR's vast experience supporting human space flight, Michael will look at how we can use technology to better prepare humans for longer duration space missions… to the Moon and to Mars.

Michael Hardy *is the Director of Innovation & Technology for KBR's Government Solutions business in Australia. He leads a team of Innovation Masters who support KBR workers and clients to continuously improve, innovate and transform programs.*
Michael's background is in training and human performance. He has been working in that sector for over 30 years, designing, developing and delivering training solutions for Defence, government and corporate workers.
As an innovation champion and advocate, Michael supports KBR's defence and space activities both in Australia and overseas. He actively seeks academic and research partners to solve customer issues using smarter processes

and new technologies. The technologies mainly focus on automation, data analytics, machine learning and wearables – to improve human performance, in training and on the job.
Michael is the thought leader behind the highly successful Navy Industry Academia training conferences, bringing together the 3 sectors to create a practitioner community and collaboration environment.

13:30 – 13:45 Zero Emissions Future and Resilience
Renata Berglas, National Strategic Workgroup Leader, Mobility Futures,
National Transport Research Organisation

Case study for hydrogen in heavy vehicles.

Renata Berglas *leads NTRO's Mobility Futures Business Group which focuses on the new and emerging technology that interacts with and on our road and rail infrastructure. Renata has extensive experience in industry development with a particular focus on hydrogen and zero emission vehicles, strategy, policy, and planning. She is currently the Independent Transport Member of Minister De Brenni's Hydrogen Taskforce, and Chair of H2Q Queensland Hydrogen Industry Cluster. Passionate about achieving policy outcomes that improve the business environment, level the playing field, and enable business to flourish.*

13:45 – 14:00 Bionics: The Untapped potential to improve defence capabilities and the lives of those who serve
Robert Klupacs, CEO, Bionics Institute

Defence force personnel need to be fitter, faster, stronger and smarter to be effective. Our defence force personnel often have chronic injury specifically arising from the roles they are asked to perform.
Bionics devices which include implantables, wearables and combinations utilising AI offer an unique opportunity to improve sensory perceptions, improve communication, monitor physiology remotely and to treat illness or injury sustained through battle or stress. The talk will highlight some of the advances made to date as well as those being developed in Australia and describe the opportunity for a win/win relationship between the Defence Industry and Australian innovation.

Mr Klupacs *has been CEO of the world famous Bionics Institute since 2017.*
A highly experienced professional, with over 35 years corporate experience, he is uniquely experienced in developing early stage intellectual property into commercial product or investable corporate vehicles. He is the Founder of 28 companies and passionate about translating Australian innovation into products which can help improve people's lives.
He is an Australian registered patent attorney who has had a wide and successful career in Australia and Asia within both private and publically traded companies as well as the academic arena.
He is especially regarded for his ability to bridge cultural divides and knowledge gaps between academics, corporations and the general investment community and internationally recognised for his ability to lead start-up organisations to mature well focused companies.
He is also heavily involved in raising funds for autism research through his role as pro-bono Non-executive Chairman of the registered charity Bioautism Limited.

14:00 – 14:15 Remote Robotic Surgical Care in to the 'Future and Beyond'
Prof. Richard Page, Director of Orthopaedic Research, St John of God and Barwon Health
Chair of Orthopaedic Surgery - Deakin University

Trauma management and surgical care in an austere or remote environment creates unique challenges. Current management is resource intensive and dependent on surgeon expertise at the site of care, with outcomes reliant on limited human resources. These limitations have a similar impact on the provision of surgery in the national setting such as remote and regional communities.
The growth in turnover of robotics in health care has grown over 300% to USD$12.6 billion in just 5 years and the potential is at the tip of the robotic iceberg. Surgical robots are increasingly embedded in operating theatres around the country and are becoming part of routine care, including orthopaedics. However, the use of these technologies in orthopaedic trauma is an underdeveloped resource, with the potential to project expertise to the injured in remote settings from regional, hostile and military to space and the next frontier.
This presentation will explore the outcomes of current surgical practice and look to the injuries and opportunities required to expand care from earth to space.

Prof Page is Academic Chair of Orthopaedics at Deakin University and Director of Orthopaedic Research University Hospital Geelong and St John of God Hospital. He is founder and Director, Barwon Centre for Orthopaedic Research and Education (B-CORE) and is a specialist shoulder, upper limb and trauma surgeon. Prior to this he served for ten years in the Royal Australian Navy with active service in Somalia and Indonesia.

He has authored over 250 referred journal articles, book chapters on shoulder, elbow and joint replacement surgery, and given over 180 scientific papers at a national or international level. Research interests include outcomes of shoulder replacement surgery, biomaterials and upper limb biomechanics, as well as orthopaedic trauma. Prof Page has been a collaborator on published Delphi Consensus guidelines in shoulder arthroplasty, rotator cuff surgery and joint replacement infections. He has extensive clinical trial experience in investigator initiated and multicentre trials. Research support awarded of $15.8 million for investigator-initiated studies and educational programmes.

Positions held include Scientific Secretary and Director to the Australian Orthopaedic Association, Clinical Advisor to the AOA National Joint Replacement Registry. President Elect of the Shoulder and Elbow Society of Australia (SESA), Trustee to the Victorian Orthopaedic Foundation (VOF) and programme lead for the Victorian Orthopaedic Trauma Outcomes Registry (VOTOR). He serves as International Faculty to the AO Trauma Foundation and Co-Chair International Shoulder Arthroplasty Consortium (ISAC).

14:15 – 14:30 Developing Renewable and Sustainable Energy Generation and Storage Technologies for a Secure Australia

Dr Gavin Collis, Principal Research Scientist, Team Leader - Emerging Energy Technologies, CSIRO

As countries around the world transition to renewable energy and low emission technologies, Australia is in a unique position to capitalise on its natural resources and research expertise to commercialise emerging solar generation and battery technologies for the Australian landscape. CSIRO has engaged with local and international partners in photovoltaic and battery technologies to facilitate Australian industries to transition to renewable technologies and establish the necessary supply chains to ensure sovereign capability.

Current energy generation and storage may not deliver the power and energy requirements for a range of emerging applications. New solutions need to be developed for the Australian context, such as CSIRO's flexible low weight colour-tuneable PV technology, fast-charging batteries, high energy density/power devices with small volumes/weights, and the ability to withstand harsh environments (i.e. remote Australian regions, portable, extreme temperatures).

CSIRO has recently formed the Revolutionary Energy Storage System Future Science Platform (FSP) to look beyond conventional materials and devices to develop the renewable energy systems that will be needed to deliver safe, clean energy, and durable solutions for the future. This presentation will highlight some of the current and future activities at CSIRO Manufacturing around photovoltaic generation and battery storage systems.

Dr Collis completed his degrees at the University of Western Australia in the physical and biological sciences before specialising in mechanistic synthetic organic chemistry for his doctorate. He accepted a Post-doctoral Fellowship at Massey University in New Zealand where he developed functionalised electroactive polymers for sensor, photovoltaic and catalytic applications. In 2001 the Nanomaterials Research Centre was formed, and he was appointed as Assistant Director, leading a synthetic R&D group.

In 2002 he accepted a position at Los Alamos National Laboratory in New Mexico where he collaborated on many multi-disciplinary projects, from designer ligands for catalysis, conducting polymers for sensing radioactive metal ions, chemical war-fare sensors, the Origins of Life project, metallo-polymer precursors for forming semiconductor metal films and sensor materials for beryllium. The portable beryllium sensor kit was patented and commercialised and the team received the LANL Outstanding Innovations Technology Transfer Award in 2006.

In 2006 he was appointed to CSIRO and has led a variety of projects developing new materials and processes for commercial applications, such as, organic electronics (photovoltaics, field effect transistors and light emitting diodes), metal ion chelators for sensing and remediation, and flame retardant textiles with domestic and international industries. Given his R&D achievements and commercial engagements, Dr Collis was awarded the CSIRO OCE Julius Career Award in 2008.

In 2022 Dr Collis was appointed as a Team Leader to the newly formed Emerging Energy Technologies Team. The team is investigating Horizon 2/3 technologies for photovoltaics and battery materials for renewable, safe and sustainable future. In 2020, Dr Collis received the prestigious, Winston Churchill Memorial Trust Churchill Fellowship Award, where he is studying ways to develop circular-closed processes for current lithium-ion batteries and sustainable and safe energy materials for emerging battery technologies.

14:30 – 14:50 Wrap up and closing remarks

Adjunct Professor (Brigadier Retd) Nagy Sorial

14:50 – 16:00 Poster presentations session 2 and Networking event

Free registration - RSVP before 25 November 2022: https://www.eventbrite.com.au/e/deakin-defence-and-security-symposium-2022-tickets-431486095527

https://www.deakin.edu.au/defence

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