



ADVANCING INNOVATION
RIIS HUB REPORT 2022–2025

ARC RESEARCH HUB FOR RESILIENT AND INTELLIGENT INFRASTRUCTURE SYSTEMS (RIIS)

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DIRECTORS REPORT



When we launched the RIIS Hub three years ago, our ambition was clear: to create infrastructure that is not only resilient and intelligent but also sustainable and future-ready. Looking back, I'm

proud to say we've delivered on that promise in ways that exceeded expectations.

From the outset, collaboration sat at the core of everything we did. RIIS brings together UNSW Sydney, the University of Melbourne, Queensland University of Technology and Western Sydney University, alongside a strong and growing cohort of industry partners across transport, water, mining, energy and smart infrastructure. This partnership model has been one of our greatest strengths. It ensured that every research outcome was shaped by real operational needs, regulatory settings and practical constraints, allowing innovation to move efficiently from concept to application.

Over these years, RIIS has delivered substantial progress across its key research themes. Our teams have developed low cost, long lifespan sensing technologies, including advanced nanosensors designed to operate in harsh and complex environments. These technologies are improving safety and reliability in applications such as mining, pipelines and critical structural assets. In parallel, RIIS researchers have

advanced robotics and autonomous systems for data collection, including marine and underwater inspection platforms, significantly reducing human risk while improving inspection coverage, consistency and efficiency.

A defining achievement of the Hub has been our leadership in digital twin technologies for infrastructure systems. RIIS has pioneered integrated spatial digital twin frameworks that combine sensing, physics based modelling, artificial intelligence driven analytics and real time data streams. A flagship outcome is our digital twin demonstrator for structural and bridge health monitoring, which delivers live insight into structural behaviour, condition and safety. This system represents an important step forward in predictive maintenance and asset management and provides a scalable foundation for deployment across Australia's transport and rail networks.

What is particularly exciting is that these innovations are already delivering measurable impact for industry and government partners. RIIS enabled Intelligent Bridge Management Systems now allow asset managers to simulate long term maintenance and renewal scenarios over many decades, transforming how investment decisions are made. Artificial intelligence driven anomaly detection tools developed through the Hub support early identification of structural degradation in offshore, water and pipeline assets, helping

prevent failures before they occur. At the same time, our spatial digital twin platforms are enabling more accurate flood forecasting, catchment monitoring and water network management, supporting improved climate resilience and emergency planning.

Beyond technology delivery, RIIS has built a vibrant and inclusive research community. Our doctoral candidates and early career researchers play a central role in the Hub's success, working directly with industry while producing high quality research with national and international recognition. RIIS students have excelled in competitive research communication events, industry showcases and technical forums, and many of our researchers contribute to the development of international standards and best practice guidance for sensing, digital twins and infrastructure resilience.

Engagement and inclusion have been equally important priorities. Through participation in National Science Week, International Women's Day activities, industry workshops and public outreach, RIIS has fostered a culture that values diversity, mentorship and impact beyond academia. These efforts ensure that the next generation of engineers and infrastructure leaders is not only technically capable, but also socially engaged and prepared to lead complex systems.

Looking ahead, the opportunities before us are significant. RIIS is scaling digital twin technologies for national transport, water and energy networks, advancing explainable artificial intelligence for predictive maintenance, and strengthening global collaborations in sensing, robotics and infrastructure intelligence. The combined challenges of climate change, urban growth and resource security demand integrated, forward looking solutions, and RIIS is well positioned to meet that challenge.

This journey has been made possible by the dedication of our researchers, the vision and engagement of our industry partners, and the continued support of the Australian Research Council. Together, we have not only addressed technical challenges, but have reshaped how infrastructure systems are conceived, managed and sustained. In doing so, we are helping to shape the future of resilient and intelligent infrastructure in Australia and beyond.

Scientia Professor Nasser Khalili

Director, RIIS Hub

Head of School, School of Civil and Environmental Engineering

UNSW Sydney

OUR RESEARCH HUB

Our Vision

"Towards productive, connected, sustainable and smart infrastructure"

About RIIS

The **Resilient Intelligent Infrastructure Systems (RIIS) Hub**, hosted by **UNSW Sydney**, is a multidisciplinary research initiative committed to transforming infrastructure through intelligent systems, advanced data analytics, and collaborative innovation.

Funded by the **Australian Research Council (ARC)** under the **Industrial Transformation Research Hub scheme (IH2101000048)**, RIIS brings together leading researchers, industry partners, and government stakeholders to address critical challenges in infrastructure resilience, sustainability, and performance.

Our Mission

RIIS aims to revolutionise infrastructure systems by integrating cutting-edge research in sensing technologies, artificial intelligence, and systems engineering. Our goal is to deliver practical, scalable solutions that enhance the safety, efficiency, and adaptability of infrastructure across Australia and globally.

What We Do

RIIS supports a diverse portfolio of research projects spanning:

- Smart sensing and monitoring of infrastructure assets
- Predictive analytics and decision support systems
- Digital twins and simulation technologies
- Sustainable and resilient infrastructure design
- Collaborative industry engagement and knowledge transfer

These focus areas enable RIIS to bridge the gap between academic research and real-world application, ensuring our work contributes meaningfully to the infrastructure sector.

Our Partners

RIIS is proud to collaborate with a strong network of industry partners, who play a vital role in co-designing and implementing innovative solutions. These partnerships ensure our research remains grounded in practical needs and delivers measurable impact.

Our University Partners

RIIS is powered by a collaboration between four of Australia's leading universities: UNSW Sydney, University of Melbourne, Queensland University of Technology, and Western Sydney

University. These institutions bring world-class engineering and infrastructure research expertise to the Hub, enabling innovative solutions to Australia's most pressing infrastructure challenges.

Led by Scientia Professor Nasser Khalili (UNSW) and Professor Abbas Rajabifard (University of Melbourne), RIIS leverages the strengths of each university's research centres and academic leaders. This partnership ensures access to cutting-edge knowledge, advanced technologies, and a multidisciplinary approach to infrastructure asset management.

Through this collaboration, RIIS connects industry with top-tier researchers to co-develop solutions that enhance productivity, resilience, and sustainability across Australia's infrastructure landscape.

Our Community

RIIS fosters a vibrant and inclusive research community, including:

- **Early career researchers and PhD students** developing the next generation of infrastructure technologies
- **Industry collaborators** contributing expertise and real-world insights
- **Government partners** shaping policy and practice through evidence-based research

Together, we are building a future where infrastructure is not only intelligent, but also responsive, sustainable, and inclusive.

OUR PEOPLE

Executive Leadership Team

The Executive Committee represents the peak decision-making body in the RIIS Hub with all decisions relating to research, deliverables, staffing, appointments, funding, operations, resourcing, commercialisation, and overall direction are debated and ratified by this Committee. The Executive Committee is chaired by the Hub Director and is made up of the Deputy Director, Chairs of Hub Committees, and Hub Business Manager.



Scientia Professor Nasser Khalili

*Director, RIIS | Head,
School of Civil and
Environmental
Engineering,
UNSW Sydney*

Professor Khalili is internationally recognised for his pioneering work in geotechnical engineering, particularly in unsaturated soil mechanics and computational geomechanics. He developed the first thermodynamically consistent framework for modelling unsaturated porous media, rendering a step change in the way such media is treated. With over \$30 million in research funding, he leads transformative projects that bridge academia and industry, shaping the future of infrastructure resilience and intelligent systems.



Professor Abbas Rajabifard

*Deputy Director,
RIIS | Director,
CSDILA, University
of Melbourne*

Professor Rajabifard is a global leader in geospatial engineering and infrastructure systems. With over \$35m in research funding, he leads geospatial knowledge and innovation with his research spans Digital Twins, infrastructure resilience, and land intelligence and geospatial data integration. He has influenced international geospatial and land policy through the United Nations, World Bank and led infrastructure strategies across the Asia-Pacific and Middle East. His work supports RIIS's mission to deliver intelligent, adaptive digital infrastructure solutions.



Professor Bijan Samali

*Lead Investigator,
RIIS | Director, Centre
for Infrastructure
Engineering, Western
Sydney University*

Professor Samali brings over four decades of expertise in structural engineering, vibration control, and infrastructure health monitoring. He has authored more than 650 publications and led major research in sustainable concrete technologies and smart infrastructure systems. His leadership continues to shape innovative approaches to infrastructure design and maintenance.



Professor Tommy Chan

*Lead Chief
Investigator, RIIS
| Professor of Civil
Engineering, QUT*

A pioneer in Structural Health Monitoring (SHM), Professor Chan has over 25 years of experience in bridge engineering across Hong Kong, China, and Australia. He integrates advanced sensor technologies and data analytics to enhance infrastructure safety and longevity. As founding President of ANSHM, he continues to lead innovations in predictive maintenance and digital twins.



**Professor
Sisi Zlatanova**

Lead Chief Investigator, RIIS | SHARP Professor, UNSW Sydney | Head, Geospatial Information Centre (GRID)

Professor Zlatanova is a global authority in 3D GIS and Spatial Digital Twins. Her research integrates BIM and GIS for urban modelling, emergency response, and indoor navigation. She has held academic roles across Europe and Asia and contributes to international standards through leadership in ISPRS, UDMS, and OGC IndoorGML.



**Professor
Ismet Canbulat**

Chief Investigator, RIIS | Head, School of Minerals and Energy Resources Engineering, UNSW Sydney | Kenneth Finlay Chair of Rock Mechanics

Professor Canbulat is a leading expert in mining engineering with over 30 years of experience. His work in ground control, rock mass classification, and geotechnical risk management supports infrastructure resilience in complex environments. He has authored over 150 peer-reviewed publications and led strategic initiatives that reinforce UNSW's global leadership in mining innovation.



Theresa Wisniewski

**Hub Business Manager
University of New
South Wales**

Theresa Wisniewski plays a pivotal role in the success of the Resilient and Intelligent Infrastructure Systems (RIIS) Hub at UNSW Sydney, where she serves as Business Manager. Since joining UNSW Sydney in 2010, Theresa has consistently brought energy, precision, and a collaborative spirit to all aspects of her work.

With a strong background in business and financial management, she is recognised for her ability to streamline operations, build cohesive teams, and translate strategic ideas into practical outcomes. Her leadership drives operational excellence at RIIS, aligning resources and processes to deliver sound management practices.

Industry Advisory Board

The high-level strategic advice to the Hub Director is provided by the Hub's Advisory Board. The Board also facilitates and advises on developing new and strengthening existing linkages between the ARC Research Hub, government, stakeholders, and industry. The Hub Director and Deputy Director provide the link between the Hub Advisory Board, the Research, Business Development, Industry Engagement and Research Training Committees and Centre operations.

Membership of the Hub's Board reflects the Hub's strong multi-disciplinary activities, chaired Garry Mostyn, a highly respected geotechnical engineer with over four decades of experience across Australia and the Asia-Pacific.



Garry Mostyn
Principal Geotechnical Engineer, PSM Adjunct Associate Professor, UNSW

Garry Mostyn has contributed to national standards including AS3798 and AS4678, and regularly provides expert evidence in legal contexts. As an Adjunct Associate Professor at UNSW, he lectures in foundation and rock engineering and has authored over 80 technical papers. Garry received the EH Davis Medal in 2019 for his contributions to geomechanics.



Léon van Berlo
Independent Interoperability Expert

Léon van Berlo is an expert in open standards for the 3D environment. He has been deeply involved in the development and alignment of standards such as openBIM, OGC, and OpenUSD. With a background spanning technology, engineering, and digital (business) transformation, Léon focuses on bridging the gap between technical capabilities and practical implementation ensuring that open 3D standards enable seamless data exchange across industries, from construction to geospatial and beyond.



Ivana Ivánová
Chair, Standards Australia, IT-004

Ivana Ivánová is a senior teaching and research academic in Spatial Sciences at Curtin University, Perth. She chairs Standards Australia's IT-004 Committee for Geographic Information/ Geomatics and the OGC Data Quality Domain Working Group, and contributes to ISO/TC 211. She leads development of the ISO 19157 standards on geographic information quality. Her expertise spans spatial data quality, metadata, provenance, spatial infrastructures, and data management.



Scott Simmons
Chief Standards Officer, Open Geospatial Consortium (OGC)

Scott Simmons is Chief Standards Officer at the Open Geospatial Consortium (OGC), overseeing technical programmes and leading the OGC Standards Program through its consensus process. He previously chaired the 3DIM Domain Working Group and contributed to geospatial standards initiatives. Scott held senior roles at CACI International and TechniGraphics after a career as a consulting and exploration geologist. He holds BSc and MSc degrees in Geology.



Liming Zhu
Director, Data61 (CSIRO)

Dr Liming Zhu leads CSIRO's Data61, Australia's national digital and AI research arm, and is a conjoint professor at UNSW. An internationally recognised leader in AI engineering and responsible AI, he contributes to global AI safety, standards and governance through the OECD, ISO and national initiatives, and has published more than 400 papers and books on trustworthy AI systems.

Chief investigators – UNSW Sydney



**Scientia Prof
Nasser Khalili**



**Prof
Hamid Ronagh**



**Prof
Stuart Clark**



**A/Prof
Binghao Li**



**Prof Dr Sisi
Zlatanova**



**Prof
Wei Gao**



**A/Prof
Wenjie Zhang**



**A/Prof
Simitkumar Raval**



**Prof
Chun Wang**



**Prof
Deo Prasad**



**A/Prof
Arman Khoshghalb**



**Dr Babak
Shahbodagh**



**Prof
Ismet Canbulat**



**Prof
Claude Sammut**



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Dr Huadong Mo



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Abbas
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**Prof
Alex Felson**



**A/Prof
Jagannath Aryal**

Queensland University of Technology



Prof
Tommy Chan



A/Prof
Michael Cholette



Em/Prof
Lin Ma

INDUSTRY PARTNERS



Western Sydney University



Prof Bijan Samali



Prof Srinath Perera



A/Prof Maria Rashidi



ASSOCIATE PARTNERS







1

RESEARCH THEME

Ubiquitous Sensing, Intelligent and Adaptive Systems

Robust, low energy sensors and actuators

Ubiquitous positioning, sensing & communications

Internet of Things (IoT) & sensing platforms

Signal processing, network and sensing optimization



PROJECT 1.1



Bridging Scales: Estimation of Continuum Properties from 2D and 3D Pore-Scale Imaging of Granular Media

This project, led by Peyman Mostaghimi is driving a new wave of innovation in soil characterisation with direct benefits for agriculture, infrastructure, and geotechnical engineering. By combining high-resolution surface imaging, micro-CT scanning, and machine learning, the team is developing a practical toolset to estimate porosity and permeability from the surface geometry of soil and rock samples.

Over the past year, the team analysed two distinct soil types Sydney Sand and Coral Sand using photogrammetry and

PROJECT LEAD Peyman Mostaghimi,
Nasser Khalili

INDUSTRY Kumul Petroleum

volumetric scanning. These methods allow for rapid, non-invasive assessment of soil structure, reducing the need for costly and time-consuming field tests. The data is now being used to train AI models and validate physics-based simulations, paving the way for scalable solutions in site evaluation, land suitability analysis, and resource exploration.

This approach offers a promising alternative to traditional soil testing, with the potential to streamline decision-making in real-world projects and improve outcomes across multiple sectors.

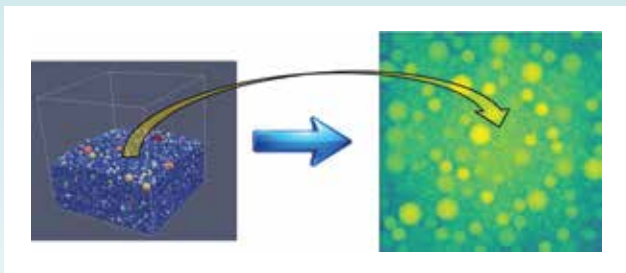


Figure 1. Creation of synthetic granular media using the Discrete Element Method and extraction of surface information for training computational models.



Figure 2. Surface imaging and volumetric scanning of granular soil sample. Left: Photogrammetry setup with controlled lighting and DSLR camera positioned to capture 50 --100 high-resolution macro photos used for 3D surface reconstruction. Right: High-resolution X-ray micro-CT scan of the same cylindrical sample, used to obtain internal structure and reference porosity data for model validation.



PROJECT 1.2



Azure Mining Technology

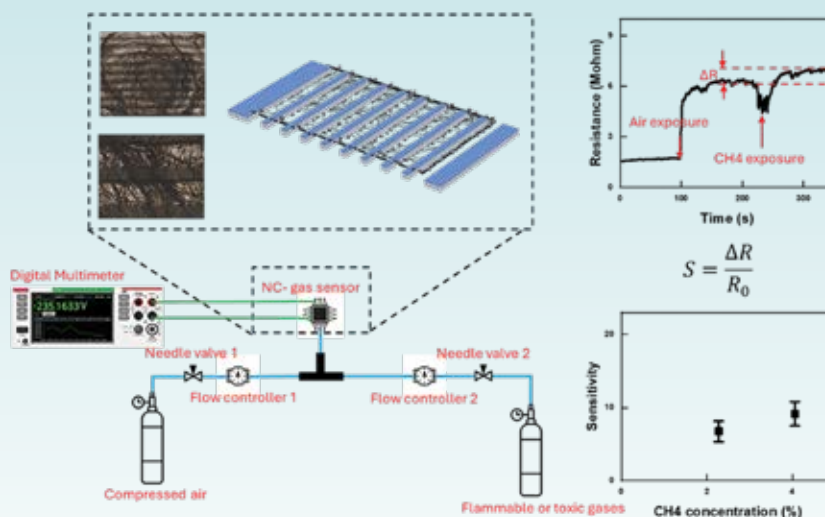
Nanosensor Integration and Manufacturing Technology for Safe Mining

This cutting-edge project has pioneered the development of advanced gas sensors using nanocomposite (NC) materials as NC-gas sensor, designed to detect toxic and flammable gases, particularly methane, at room temperature with exceptional precision. The research team successfully engineered a low-power, robust Micro-Electro-Mechanical Systems (MEMS)-based sensing system, validated through a custom-built gas testing vessel. Among the many sensor prototypes, the prototype of multi-component doping with optional carbon black has made

PROJECT LEAD Jing (Camille) Zhao, Ismet Canbulat

INDUSTRY Azure Mining Technology

a breakthrough. Its sensitivity at room temperature is as high as over 9%, and it can detect up to 4% methane in the air without saturation failure and has fast recovery and long-term stability. Microscopic analysis revealed a unique network-like nanostructure that dramatically increased the active surface area, amplifying gas interaction efficiency. These innovations mark a significant leap forward in mining safety technology and setting the stage for transformative industrial applications in hazardous gas detection.





PROJECT 1.3 | **ROOBUCK**

Text message broadcast- ing system for underground mines and camera-based tracking & obstacle avoidance

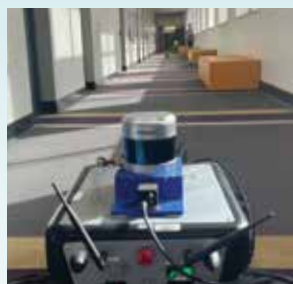
This pioneering project is revolutionising communication and safety in underground mining environments through the development of a robust text message broadcasting system and an advanced camera-based tracking and obstacle avoidance solution. Unlike conventional systems used in public spaces, this technology is specifically engineered to withstand the harsh conditions of Australian underground mines, marking a significant leap forward in mining infrastructure.

At its core, the Roobuck server software enables real-time dissemination of critical messages via Ethernet, Wi-Fi, and LTE networks, enhancing situational awareness

PROJECT LEAD	Binghao Li, Ismet Canbulat
INDUSTRY	Roobuck

and operational coordination. Complementing this is a cutting-edge camera-based system designed to track personnel and vehicles with high precision, offering richer data than traditional ultrasound or radar-based methods. Leveraging AI, the system promises improved safety outcomes and cost-efficiency, with fewer blind spots and greater adaptability.

Key milestones achieved include the successful deployment of a digital kiosk and tagboard system for managing PPE and safety devices, and a pilot program for self-rescue kit tracking at a mine site. The team also conducted foundational research into object recognition in underground settings, laying the groundwork for future innovations.





PROJECT 1.4 |  Azure Mining Technology

Underground Navigation and Obstacle Avoidance for Unmanned Equipment

This cutting-edge project is revolutionising autonomous operations in GPS-denied, cluttered underground environments. Over the past year, the team has engineered a robust, multi-layered solution that combines precision localisation, intelligent control, and real-time responsiveness. Highlights include a custom-designed UWB-based localisation system achieving sub-3-meter dynamic accuracy, and a nanosecond-level multi-sensor synchronisation architecture that ensures seamless data fusion. The project also introduced a novel composite vector field control algorithm, enabling autonomous equipment to track paths, maintain boundaries, and avoid obstacles with remarkable agility.

PROJECT LEAD	Bingaho Li, Ismet Canbulat
INDUSTRY	Azure Mining Technology

A lightweight, ROS-based embedded control platform was developed to support SLAM, dynamic path planning, and multi-protocol communication, ensuring adaptability across diverse mining scenarios. These innovations were rigorously validated through field trials at the China Coal Research Institute (CCTEG) and UNSW, showcasing reliable obstacle detection and collision-free navigation in simulated tunnels and real-world corridors. The project's impact is underscored by its publication in IROS 2024, IPIN 2024, and the International Journal of Coal Science and Technology, positioning it at the forefront of underground robotics research.

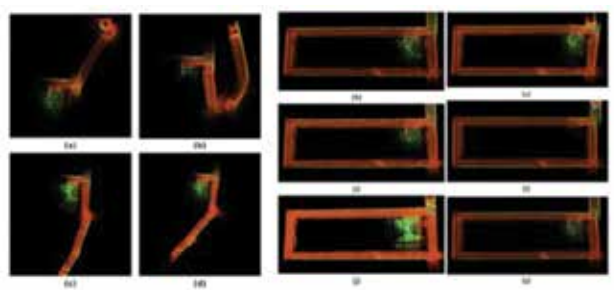


Figure 1. Impacts of time delay on Mapping in a simulated tunnel at CCTEG, Changzhou

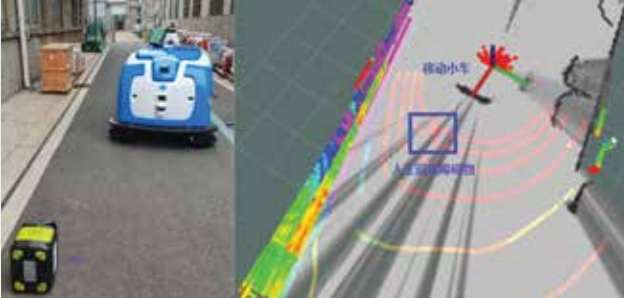



Figure 2. Setup of obstacle detection experiment



PROJECT 1.5 

Advancing Digital Core Analysis for Enhanced Reservoir Characterisation

This project, led by Peyman Mostaghimi, aims to advance digital rock analysis for full core characterisation, with direct applications in reservoir engineering, carbon sequestration, and underground hydrogen storage. While digital rock physics has been adopted in the oil and gas industry, its application to full-core analysis remains limited, constraining its full integration with large-scale reservoir characterisation. By combining data obtained from multiscale imaging at different resolutions with machine learning methods, the aim is to generate high-resolution rock images at full-core scales that can be characterised in terms of their multiphase attributes and seamlessly integrated with larger scale data and reservoir models.



PROJECT LEAD	Peyman Mostaghimi, Nasser Khalili
INDUSTRY	Kumul Petroleum

The outcomes of this project will significantly enhance the predictive capabilities of digital rock physics, improving reservoir characterisation by reducing uncertainty and bridging the gap between pore-scale observations and field-scale applications. Beyond traditional oil and gas reservoirs, this approach has substantial potential for emerging applications including carbon sequestration, underground hydrogen storage, contaminant transport modelling, and soil research, where understanding fluid flow and reactive transport at multiple scales is critical. This work represents a step toward scalable digital workflows that can streamline subsurface characterisation and improve decision-making across the energy transition and environmental sectors.



“

This investment enables strong and practical collaboration between top researchers and industry partners focused on deploying innovative and integrated technologies to improve urban infrastructure, transport, water, resource, and energy management.

”

Dr Richard Johnson
Deputy Chief Executive Officer
Australian Research Council

RIIS Hub launch
Friday 28 April 2023



Organization
Market Research
Design
Accounting
Finance
Marketing
Production

Product
Business
Management
Marketing
Manufacturing
Planning

0.001

/Administration
/Human Resources
/Legal
/Accounting
/Finance
/Marketing
/Publicity
/Promotion
/Research
/Business
/Development
/Engineering
/Manufacturing
/Planning

2

RESEARCH THEME

Data collection, security, and integration

Robotics, satellite, UAV, autonomous systems

Big data management storage & transmission

Data security, robustness and reliability



PROJECT 2.1 

Developing Remotely Operated Submersibles for Pier Defect Detection and Integrity Assessment

The RIIS S-AUV project is pioneering a transformative approach to marine pile inspection, replacing traditional diver-based methods with a cutting-edge semi-autonomous underwater vehicle. Designed to operate with minimal surface intervention, the S-AUV leverages advanced stereo vision and sonar technologies to deliver precise, real-time assessments of structural integrity in challenging underwater environments.

Over the past year, the project has achieved remarkable milestones. A fully assembled team has successfully conducted pool-based trials, refining sensor configurations and validating underwater performance. The integration of a sophisticated multi-modal sensing suite—

PROJECT LEAD	Claude Sammut, Nasser Khalili, Will Midgley
INDUSTRY	Kumul Petroleum

including stereo cameras, event-based sensors, high-resolution sonar, acoustic positioning systems, IMUs, and barometric sensors—marks a significant leap forward in underwater data acquisition. This rich dataset is a first in its class, enabling unprecedented insights into underwater mapping and localisation.

With the software architecture now in place and open-water testing scheduled for Q3 2025, the project is poised to enter its next phase: finalising sensor selection and launching full-scale hardware and software development. This initiative not only enhances safety and efficiency but also exemplifies RIIS's commitment to innovation and excellence in research-driven engineering.

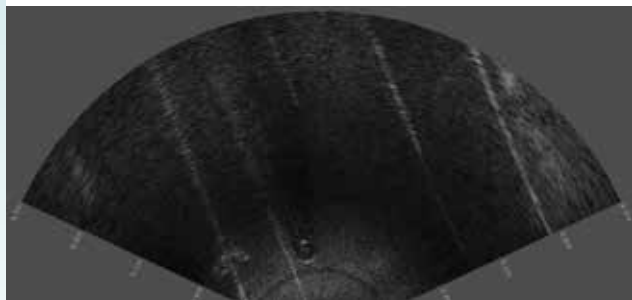


Figure 1. Example sonar return from pool testing showing a bucket on the bottom of the pool and lane ropes



Figure 2. Sensor suite installed on UNSW's existing tethered remotely operated vehicle (ROV)



Figure 3. Project team undertaking sensor suite testing in the UNSW pool



PROJECT 2.2 |  **IPWEA**
INSTITUTE OF PUBLIC WORKS
 ENGINEERING AUSTRALASIA

Development of Intelligent Bridge Management Systems (iBMS) Using Digital Twins and Decision Support Systems

The RIIS-iBMS project is revolutionising bridge asset management by fusing cutting-edge Digital Twin (DT) technology with AI-driven Decision Support Systems (DSS). This forward-thinking initiative is building a dynamic platform that transforms raw sensor data into actionable insights, enabling predictive maintenance and long-term infrastructure planning. Over the past year, the team has successfully developed a working prototype that integrates real-time monitoring from advanced sensors into a scalable DT framework. Deep learning algorithms now autonomously detect structural anomalies, assess performance, and recommend targeted maintenance strategies dramatically reducing manual inspections and enhancing lifecycle efficiency.

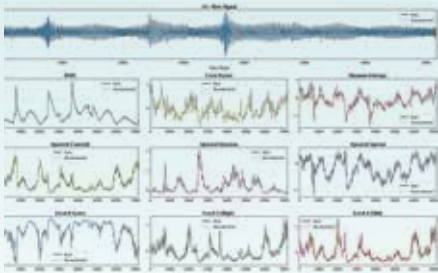
Field deployments on a cable-stayed bridge in Sydney have validated the system’s capabilities, with accelerometers and displacement sensors capturing live structural responses. These data streams feed into high-performance DT environments, where AI models correlate sensor signals with structural health metrics. A standout

PROJECT LEAD	Maria Rashidi, Bijan Samali
INDUSTRY	IPWEA

achievement includes a 100-year maintenance simulation, offering unprecedented foresight into component degradation, collapse risk, and optimal intervention planning. RIIS-iBMS is setting a new benchmark for intelligent infrastructure management driving innovation, safety, and sustainability across Australia’s transport networks.



Sensor installation and inspection activities conducted on cable-stayed bridge in Sydney. Fieldwork focused on deploying accelerometers and displacement sensors to collect real-time structural response data



Results from a 100-year maintenance planning simulation for a cable-stayed bridge using the DSS within iBMS. The visualizations show (a): Distribution of condition of bridge components over time; (b) the probability distribution of bridge collapse risk; (c): the maintenance actions across components.



PROJECT 2.3



Real-time Downhole Characterisation and 3D Reconstruction

The RIIS Hub is leading a technological shift in subsurface exploration, delivering high-impact outcomes for the energy sector. Under the leadership of Professor Stuart Clark and PhD candidate Vladislav Alekseev, the team is pioneering physics-informed machine learning to address the escalating costs and declining success rates of offshore drilling where exploration can exceed \$130 million per well with only a 20% success rate.

This year, the project achieved major milestones: a comprehensive review of over 8,000 publications, development of realistic 2D geological models, and a robust workflow for generating synthetic seismic data with real-world artifacts. These innovations are already enhancing seismic data quality and accelerating downstream processing.

A standout achievement includes publication in *Gondwana Research*, demonstrating how sparse datasets can be leveraged to reconstruct petroleum system histories offering a powerful tool for de-risking exploration. The team also engaged in fieldwork with Fender Geophysics, collecting high-resolution geophysical data and strengthening industry-academic collaboration.

PROJECT LEAD Stuart Clark, Nasser Khalili

INDUSTRY Kumul Petroleum

Looking ahead, the project is scaling to generate over 10,000 3D geological models, integrating uncertainty quantification and geophysical constraints. This work is positioning Australia as a global leader in AI-driven exploration, delivering smarter, faster, and more cost-effective solutions for the resources sector.



Figure 2. Prof. Stuart Clark (left) with A/Prof. Martin Andersen (UNSW), a UNSW Civil and Environmental student and Dr. James Daniel (fender Geophysics) discussing resistivity tomography results at Bell's Point Chair in Austinmer, NSW.





3

RESEARCH THEME

Modelling, Simulations and Prognostics

Predictive modelling simulation & performance assessment

Physics-informed artificial intelligence machine learning

Real-time analytics – adaptive decisions



PROJECT 3.1 | 

Building resilience to cyber-physical power systems (CPPS) under climate-related disasters

This cutting-edge project is driving innovation in the resilience of cyber-physical power systems (CPPS) against climate-induced disruptions, particularly violent windstorms. In collaboration with Advanced United Technologies Pty Ltd, the team is developing a suite of prescriptive analytics tools that combine distributionally robust optimisation, machine learning, and GIS-based visualisation to support strategic planning, emergency response, and system recovery.

Over the past year, the project has delivered major breakthroughs, including scalable forecasting models, resilient optimisation frameworks, and a cloud-based decision-support platform co-developed with NovaStar

PROJECT LEAD	Huadong Mo
INDUSTRY	Advanced United technologies

Technologies. This platform integrates digital twin and edge computing capabilities to enable real-time data ingestion, scenario simulation, and adaptive online control, empowering energy operators to make smarter, faster decisions under weather uncertainty.

The project's impact is amplified through high-impact publications, real-world trials with Essential Energy, and the launch of a new TRaCE-funded initiative focused on net-zero energy buildings under climate change. Together, these efforts are shaping the future of intelligent infrastructure, aligning with national resilience goals and setting new standards for climate-adaptive energy systems.



Dr Huadong Mo and Advanced United Technologies Pty Ltd visited Infnitev to explore the use of repurposed energy storage in power systems to enhance grid resilience and provide cost-effective backup power.



PROJECT 3.2



Development of Computational Tool for Data-Driven Structural Safety and Service Life Prediction

This pioneering project has delivered a cutting-edge computational tool that fuses data analytics, structural reliability, and lifecycle modelling to revolutionise how we assess and design resilient infrastructure. By integrating real-time data, environmental exposure, and material degradation, the tool empowers smarter decision-making and enhances the sustainability and longevity of engineering structures.

A major milestone was the successful application of our integrated design optimisation framework to a 19-storey modular building in Macquarie Park, developed in collaboration with Lindenbaum, Space Labs Australia, and Freecity. This framework



PROJECT LEAD Wei Gao

INDUSTRY Lindenbaum Pty Ltd

informed both the structural layout and whole-of-life performance assessment, including durability and degradation pathways.

Our lifecycle assessment (LCA) studies provided robust, quantitative evidence on carbon emissions, energy use, and material reusability critical inputs for our partner's Green Star 5-Star Building Certification. Beyond immediate industry impact, we've launched advanced research into mechanical metamaterials and digital twins, paving the way for programmable modular systems and real-time structural health monitoring. This project not only delivers tangible outcomes but also sets the stage for transformative innovation in the built environment





PROJECT 3.3



Asset Institute®
OFFICE SUSTAIN TRANSFORM

serco

Modelling Degradation of Key Components of Building HVAC Systems

This innovative project is advancing the way commercial buildings manage HVAC system reliability and maintenance. HVAC systems are central to indoor air quality, thermal comfort, and energy efficiency factors that directly impact operational performance and regulatory compliance. By integrating smart maintenance tools and Building Management Systems (BMS), the project supports a shift toward data-driven, sustainable building operations.

Using real-world data from an industry partner, the team analysed maintenance work orders focusing on mechanical assets, particularly air conditioning units. The study revealed that

PROJECT LEAD Michael Cholette, Tommy Chan

INDUSTRY Asset Institute / Serco

while many units showed minimal issues, one exhibited a significantly higher breakdown rate. A predictive modelling approach was applied to assess its degradation trend, revealing an escalating risk of failure over time. This insight challenges traditional random-failure assumptions and highlights the value of proactive maintenance strategies.

The project is now delving deeper into work order notes to uncover root causes of HVAC degradation. These findings will inform smarter maintenance policies, reduce energy waste, and extend asset lifespans delivering both environmental and economic benefits.





PROJECT 3.4 

Structural Integrity Assessment of Port Systems through Anomaly Detection Using Dynamic Signature Analytics and Small Strain Vibration from Wave Action

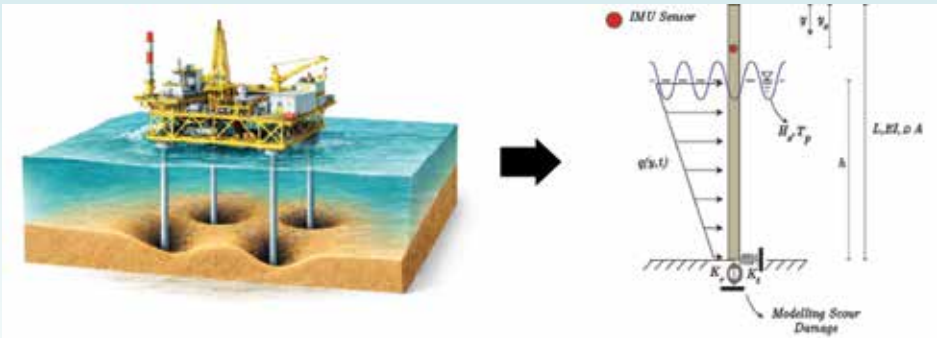
Battery-powered and offshore infrastructure monitoring is often constrained by scarce labeled damage data, evolving operational regimes, and the need for uninterrupted service. This work proposes an unsupervised anomaly detection framework that monitors a pseudo regression error derived from a single IMU sensor measurements. Multi-view signals extracted from the IMU are fused using Johansen cointegration to compute a onedimensional pseudo target that captures the stable common relationship among views under healthy operation.

A regression model is trained exclusively

PROJECT LEAD	Mohsen Mousavi, Nasser Khalili
INDUSTRY	Kumul Petroleum

on intact data to predict this pseudo target from the multiview.

IMU inputs. During operation, the prediction residual (pseudo target minus predicted pseudo target) is tracked as a damage-sensitive feature: deviations from the learned healthy mapping produce elevated residual energy, enabling real-time anomaly detection without prior damage information or service interruption. A deployable decision rule is obtained by calibrating a robust threshold from intact residual statistics, supporting reliable monitoring under realistic environmental and operational variability.







4

RESEARCH THEME

Infrastructure Health Monitoring and Predictive Maintenance

Degradation quantification & failure prediction Risk & safety

Service life assessment

Remedial & renewal technologies



PROJECT 4.1 | GeoAI

Automated Scan-vs-BIM for Real-Time Construction Progress Management of Infrastructure Projects

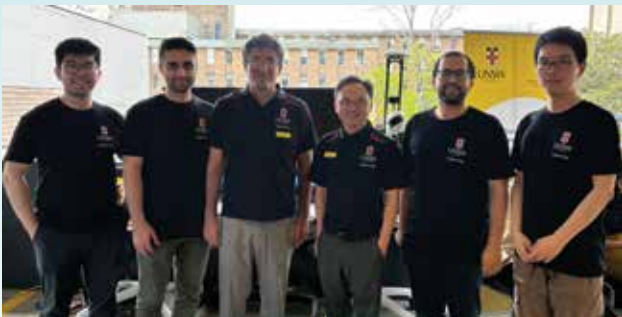
This cutting-edge project, led by A/Prof. Johnson Shen, Prof. Sisi Zlatanova, and Prof. Nasser Khalili at UNSW Sydney in collaboration with GeoAI, is revolutionising infrastructure construction through intelligent automation. By bridging the gap between traditional data workflows and the urgent need for real-time progress tracking, the team has developed a transformative system that integrates mobile LiDAR scanning, 360-degree imaging, and advanced machine learning algorithms.

The project has made significant strides across three major NSW infrastructure sites Jarvis Bay Road Intersection, Western Sydney Airport, and the Gateway project at Kingsford Smith

PROJECT LEAD	Johnson Shen
INDUSTRY	GeoAI

Airport. A mobile mapping system combining GNSS and LiDAR sensors was successfully deployed, enabling precise and efficient data capture. Innovative Scan-vs-BIM algorithms, developed by PhD researchers, now allow for automated comparison of site conditions against digital models, delivering real-time insights and enhancing decision-making.

With six PhD students actively contributing and three conference papers published, this project is not only advancing technical capabilities but also fostering the next generation of research talent. The creation of digital construction twins marks a pivotal step toward smarter, more responsive infrastructure development.



Mikael Gilbert (PhD Candidate); Milad Mousavi (RIIS PhD Candidate); Dr Khalegh Barati (Lecturer); A/Prof Johnson Shen (RIIS CI); Saeed Heidary (RIIS PhD Candidate); Jack Yafei Sun (RIIS PhD Candidate).



Mobile Mapper



PROJECT 4.2 |  **Asset Institute®**
OPTIMIZE. SUSTAIN. TRANSFORM. | **COVARIS**

Rail Reliability Modelling and Maintenance Decision Support

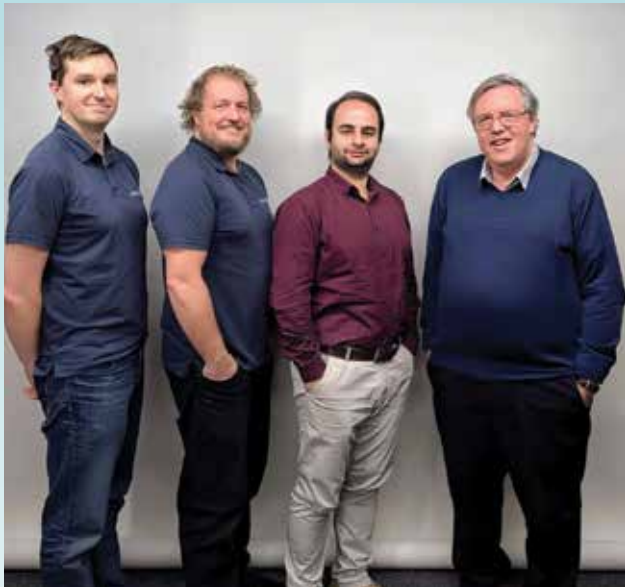
This pioneering project is transforming how the Australian rail industry approaches asset reliability and maintenance planning. With over a million train trips daily and a \$29 billion economic footprint, the stakes for safe and efficient rail operations are high. The project tackles the critical challenge of predicting and managing surface defects such as squats and fatigue cracks that emerge from cyclic loading and material degradation.

By integrating diverse data sources and applying advanced statistical modelling, the team has developed a predictive framework that forecasts defect occurrences and informs optimal inspection schedules. A standout innovation was the estimation of the oldest defect's age, a key indicator of derailment risk. This breakthrough enables tailored inspection regimes across different tracks, enhancing safety and operational continuity.

The project's impact extends beyond research. A successful internship with industry partner Covaris Pty Ltd not only strengthened university–industry ties but also showcased the practical value of the

PROJECT LEAD	Micheal Cholette, Tommy Chan
INDUSTRY	Asset Institute / Covaris

modelling approach. This collaboration exemplifies the project's commitment to real-world application and continuous improvement in rail asset management.



Internship at Covaris Pty Ltd; from left to right Mr. Nicholas Lyon, Mr. David Bessell, Mr. Saeed Khalaj, Dr. Bob Platfoot.



PROJECT 4.3



FREDON

Stochastic Degradation Modelling and Maintenance Optimisation for LED Lighting Systems

This forward-thinking project is redefining how commercial buildings manage the performance and upkeep of LED lighting systems. With thousands of multi-component units operating independently yet collectively influencing overall lighting quality, the challenge lies in maintaining optimal illumination while minimising disruptions and resource use.

To address this challenge, an opportunistic maintenance- optimisation framework was developed, integrating stochastic degradation models of LEDs with advanced 3D simulations leveraging Revit and Radiance to visualise lighting performance and asset layout. The framework was deployed on a real-world office

PROJECT LEAD Micheal Cholette, Tommy Chan

INDUSTRY Asset Institute / Fredon

floor, yielding Pareto-optimal maintenance strategies that trade off system performance, operational disruption, and resource consumption. By presenting a continuum of strategies, the approach enables facility managers to make data-driven decisions tailored to their specific operational priorities.

A principal advantage of this framework is its ability to conduct real-time performance analysis and to adapt maintenance policies to varying building and lighting system configurations. This flexibility facilitates the design of bespoke strategies that optimise efficiency, enhance sustainability, and secure long-term asset reliability.





“

We're excited Emerson has joined our Industry Partnership and will closely work with our Melbourne University CSDILA team. ARC's RIIS will deliver transformational technologies to address Australia's critical infrastructure needs. It will advance in data technology and analytics, infrastructure monitoring, sensor technology, digital twin capabilities to deliver resilient and adaptive infrastructure systems in urban, energy and resources sectors. All three sectors are critical to Australia's prosperity and well-being.

”

Prof Abbas Rajabifard
*Director of CSDILA and
Deputy Director of the Hub*





5

RESEARCH THEME

Spatial Data Infrastructures, Digital Twin and Decision Support

Integration & structuring of data & prognosis

Digital twins & decision support

Visualisation, virtual reality & interactive guidance systems

Adaptive, intelligent & resilient design



Infrastructure Protection Through Real-Time Monitoring and Predictive Modelling During Flash Flood Events

This project is pioneering a transformative approach to infrastructure resilience in the face of flash flooding. By harnessing cutting-edge Internet of Things (IoT) sensors, digital twin technologies, and high-resolution 3D building data, the project is developing sophisticated, real-time flood forecasting models. These models empower emergency services with timely, data-driven insights, significantly enhancing early warning systems and enabling proactive community alerts and infrastructure safeguarding.

This year, the project achieved several key milestones. A comprehensive review of spatiotemporal flood modelling laid the groundwork for three advanced forecasting models tailored to Townsville, Queensland. Leveraging local water level and rainfall data,

PROJECT LEAD	Jagannath Aryal
INDUSTRY	Rockfield Technologies / Veris Australia / Woolpert Asia Pacific / Geoscape Australia

the team integrated new IoT sensors and conducted site inspections across Fishermans Bend and Elster Catchments to assess deployment feasibility. Collaborations with LiXiA and Melbourne Water are progressing sensor placement strategies, while permissions from Port Phillip Council are being finalised.

The integration of Townsville's building footprint data into the CSDILA Digital Twin platform marks a major leap forward, enabling dynamic visualisation of flood impacts. A research paper submitted to *Advanced Sustainable Systems* showcases the project's innovative use of multi-sensor data and deep learning for smarter urban flood forecasting positioning this RIIS project at the forefront of sustainable infrastructure protection.



Site inspection for new sensor deployment in Melbourne (Elster catchment-above ground)- 8 July.



PROJECT 5.2



Integrating Spatial Digital Twin with Automation Systems in Smart Infrastructure Asset Management

This project is driving innovation in smart infrastructure by bridging the gap between spatial digital twin technologies and automation systems. With a focus on enhancing interoperability and connectivity, the team is tackling long-standing challenges in industrial asset recognition and localisation. By applying generative AI and advanced mathematical modelling, the project is developing open-vocabulary object detection frameworks that promise greater accuracy, reliability, and scalability in complex industrial environments.

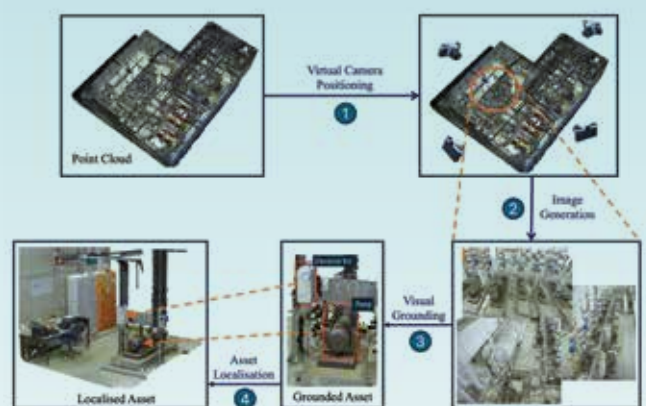
Significant progress has been made this year. The team identified key knowledge gaps in modelling brownfield industrial sites and proposed a groundbreaking framework for 3D asset detection using both imagery and point cloud data. This approach is tailored for large-scale, data-rich industrial settings, offering a robust pathway to smarter asset management. Multiple publications in leading journals and conferences have amplified the project's impact, while a standout achievement—the People's Choice Best 3-Minute Thesis

PROJECT LEAD Abbas Rajabifard

INDUSTRY Emerson Process Management Australia/
Rockfield Technologies

Presentation at the Information Resilience PhD School—highlighted the project's relevance and appeal across disciplines.

This work positions the project at the forefront of intelligent infrastructure systems, paving the way for more adaptive, responsive, and resilient asset management solutions.



A zero-shot 3D asset detection and localisation method for industrial point clouds, enabling recognition of unseen asset categories with minimal supervision.



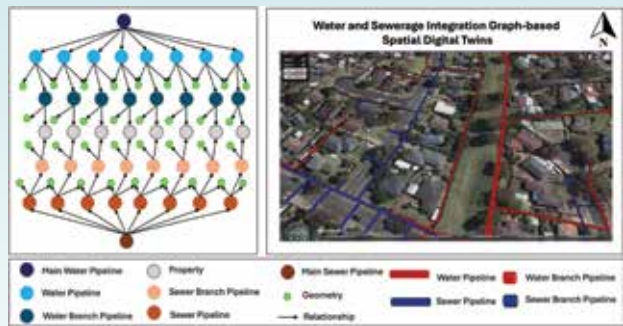
Data Integration with Spatial Digital Twin for No Spill Network and Pipeline Monitoring

This project is advancing the future of water infrastructure management by developing a spatial digital twin framework designed to prevent pipeline spills and enhance environmental resilience. By integrating multi-dimensional data (2D and 3D) with real-time micro-climate predictive models and IoT-based sensing technologies, the project delivers a scalable, intelligent solution for predictive maintenance and continuous monitoring of water utility networks.

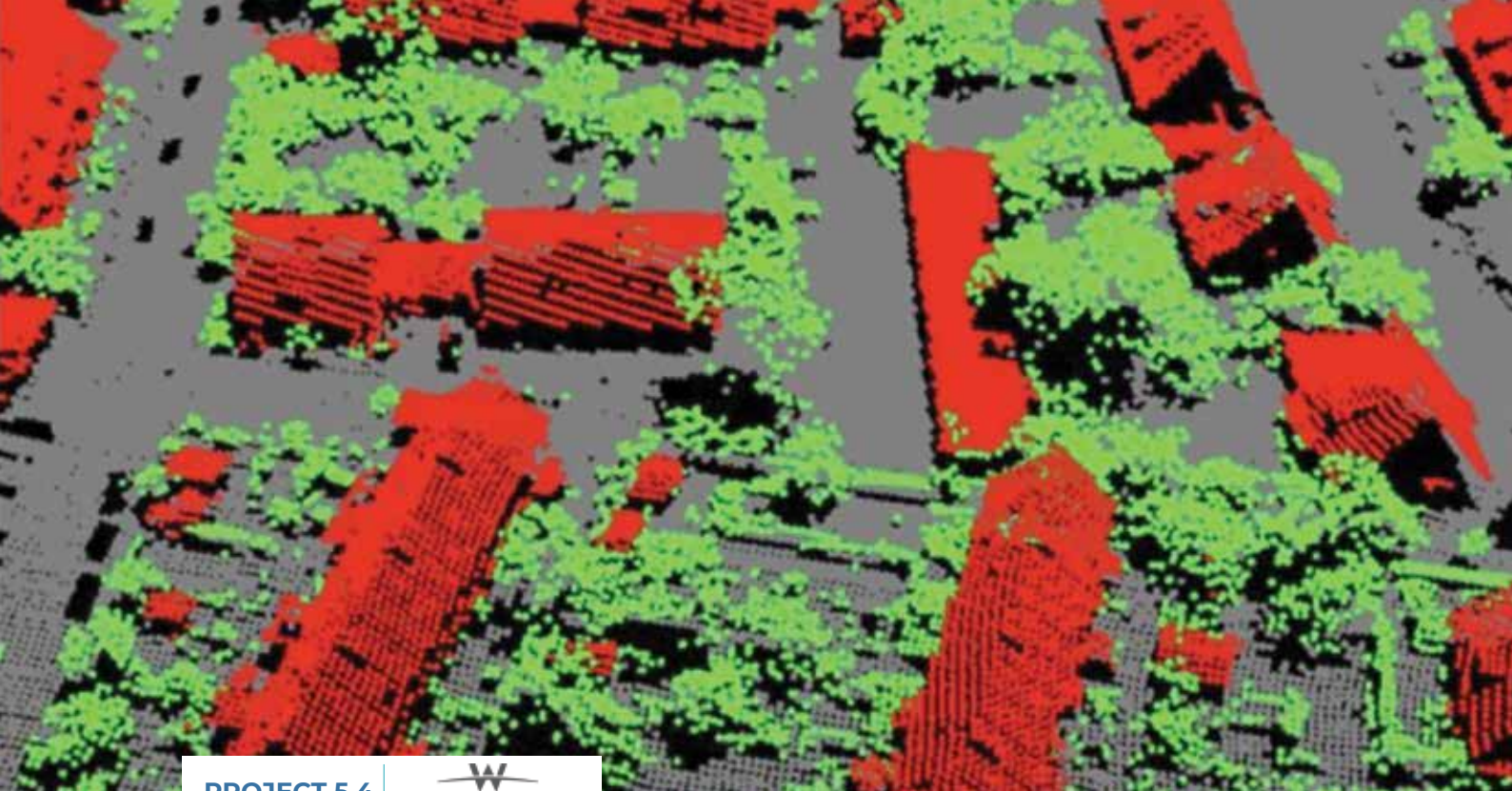
Key achievements this year include the creation of a 3D graph database tailored for water infrastructure and the development of a detailed 3D city model for the Mornington Peninsula case study. A sophisticated building

PROJECT LEAD	Jagannath Aryal
INDUSTRY	Rockfield Technologies

information model was also constructed for a water treatment facility, supporting more precise asset tracking and operational planning. The team implemented watershed-scale stormwater strategies and identified high-risk overflow zones, runoff hotspots, and natural drainage pathways within the Tanti Creek catchment. Spatially coded obstacles to water flow and zones for wastewater management intervention were mapped, providing actionable insights for utility operators. The project's impact was further recognised through a publication in the *Tunnelling and Underground Space Technology Journal*, showcasing its contribution to sustainable and resilient water infrastructure systems.



Graph Database and 3D models for Case Study in Peninsula



PROJECT 5.4



Advanced Point Cloud Segmentation for Infrastructure and Environmental Resilience

This project is pushing the boundaries of aerial LiDAR point cloud analysis to support smarter infrastructure planning and environmental resilience. Focused on overcoming real-world challenges such as noise, misclassification, and occlusion in complex urban and peri-urban environments, the research is developing advanced segmentation techniques that improve the accuracy and efficiency of spatial data processing.

Key achievements include the identification of critical industry pain points in point cloud segmentation particularly in ground filtering

PROJECT LEAD Jagannath Aryal

INDUSTRY Woolpert Asia Pacific

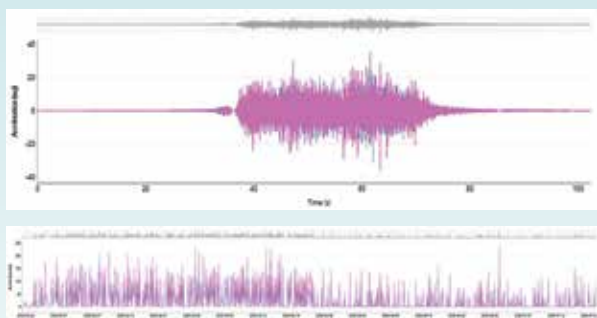
and class misclassification. Through a hands-on collaboration with Woolpert, the team has developed novel frameworks for point cloud processing, incorporating artificial intelligence to address noise segmentation with greater precision. These innovations are paving the way for more reliable and scalable modelling of infrastructure and natural landscapes. A journal paper currently under review with IEEE Geoscience and Remote Sensing Letters highlights the project's technical contributions and its potential to transform spatial data workflows in infrastructure and environmental applications.



PROJECT 5.5 | **South East Water**  **Rockfield**
Reimagine. Transform.

Structural Health Monitoring of Bridges: A Digital Twin Demonstrator

This project is revolutionising bridge asset management through the deployment of a live Digital Twin platform for heritage steel truss rail bridges in Victoria and New South Wales. By integrating 3D/GIS BIM structural models with advanced IoT sensor networks including accelerometers, strain gauges, and environmental sensors the system streams real-time data into a cloud-based analytics engine. This enables continuous structural health monitoring, automated anomaly detection, and risk-based maintenance recommendations, shifting from traditional calendar-based inspections to intelligent,



Accelerometer and strain gauge calibration rig at University of Melbourne lab, ensuring sensor precision.

PROJECT LEAD	Abbas Rajabifard
INDUSTRY	South East Water Rockfield Technologies

data-informed asset management.

Key milestones include the extraction of natural frequencies and mode shapes under ambient excitation, validating the accuracy of the structural models. Drone surveys have produced high-resolution 3D photo mesh models, enhancing visualisation and refining finite element analysis. The launch of an interactive web dashboard now allows asset managers to monitor live frequency trends, strain hotspots, and environmental conditions empowering proactive decision-making and extending the lifespan of critical infrastructure.



Digital Twin dashboard screenshot showing real-time data and frequency shifts and strain maps for targeted maintenance planning.



PROJECT 5.6 |  Sterling. 

Welcoming Sterling Infrastructure as a 2025 Industry Partner

The RIIS Hub will accelerate the future of infrastructure monitoring through its flagship Digital Twin for Bridge Health Monitoring Demonstration, led by Centre for Spatial Data Infrastructures and Land Administration (CSDILA) at the University of Melbourne. This initiative, will integrate real-time sensor data with advanced 3D modelling to deliver a live, cloud-based Digital Twin platform. The advancement of analytics in this demonstration will enable early detection of structural issues, optimise maintenance schedules, and support data-driven decision-making, transforming how ageing rail and road infrastructure is managed.

In 2025, Sterling Infrastructure will join as a new industry partner, working closely with the Australian Rail Track Corporation (ARTC), the government-owned corporation responsible for managing and maintaining much of Australia's interstate rail network. Their combined expertise will strengthen field deployment and operational support to complement the research initiatives. Aligned with RIIS themes

PROJECT LEAD Abbas Rajabifard / Maryam Nasim

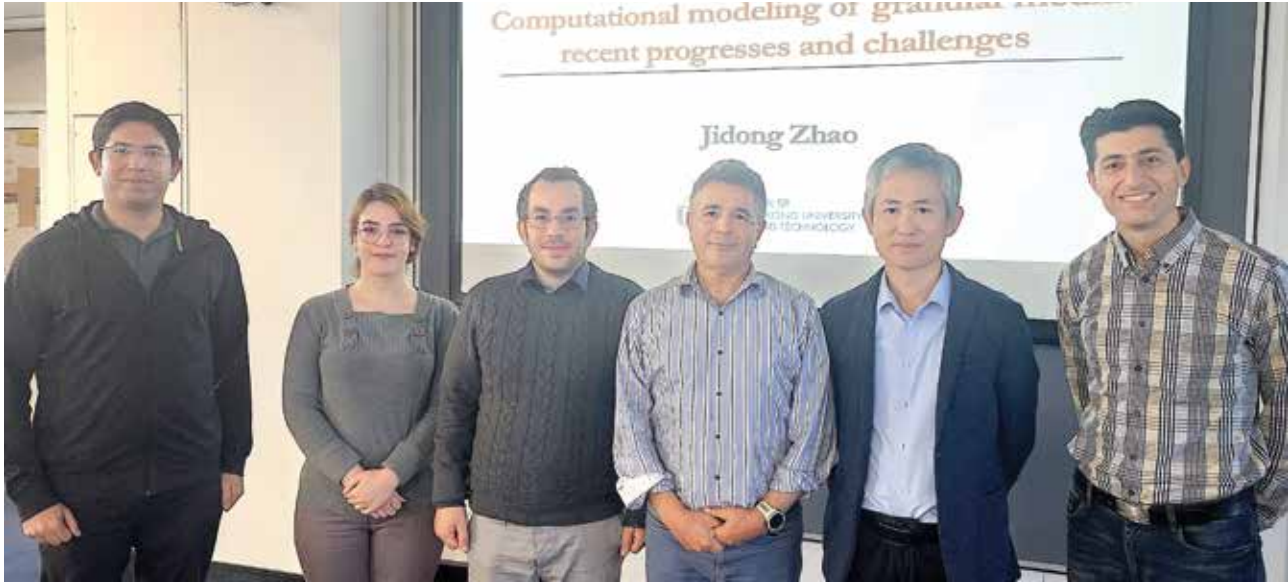
INDUSTRY Sterling Infrastructure / Australian Rail Track Corporation (ARTC)

in sensing, predictive maintenance, and spatial data infrastructures, the project will showcase scalable IoT networks and modular analytics.

Key milestones will include the delivery of a live digital twin prototype for rail bridges health monitoring and a dissemination package, positioning the RIIS Hub as a national leader in digital engineering for transport infrastructure.



OUR VISITORS



Professor Jidong Zhao from The Hong Kong University of Science and Technology (HKUST)

UNSW was honoured to welcome Professor Jidong Zhao from The Hong Kong University of Science and Technology (HKUST), a world-renowned expert in computational granular mechanics. His seminar, “Computational Modelling of Granular Media: Recent Progresses and Challenges”, delivered in collaboration with the UNSW Centre for Infrastructure Engineering Safety (CIES) and the RIIS Hub, drew strong interest from across the engineering research community.

Professor Zhao introduced a powerful multiscale simulation framework that integrates advanced computational techniques including FEM, MPM, DEM, NLCD, and PE highlighting its broad applicability across civil, mining, chemical, coastal, offshore, agricultural, and pharmaceutical

engineering. His insights underscored the pivotal role granular media mechanics play in shaping resilient infrastructure systems.

The visit fostered meaningful engagement between Professor Zhao and RIIS-affiliated researchers, including Dr Babak Shahbodagh, Nazanin Mahboobi Motlagh, Professor Nasser Khalili, and Dr Arman Khoshghalb. These exchanges not only deepened technical dialogue but also reinforced RIIS’s commitment to global collaboration and innovation.

Professor Zhao’s distinguished appointments as Director of the Computational Granular Mechanics Lab at HKUST, Chang Jiang Scholar Chair Professor (Ministry of Education, China), and editorial leader for *Computers and Geotechnics* and *Granular Matter* further amplified the significance of his visit.

Professor LiLi Du from the University of Florida

As part of National Science Week, the RIIS Hub proudly welcomed Professor LiLi Du from the University of Florida to UNSW an inspiring visit that spotlighted the future of intelligent transport systems. Her seminar, “Robust and Resilient Coordinated and Distributed Route Navigation Systems for Connected Vehicles Subject to Random Communication Delays & Interruptions”, delivered cutting-edge insights into the challenges and opportunities of connected vehicle networks.

Co-hosted by Associate Professor Johnson Shen and the UNSW Centre for Infrastructure Engineering and Safety, the event exemplified RIIS’s commitment to fostering global research partnerships and advancing solutions to Australia’s infrastructure challenges.

Professor Du’s visit sparked dynamic discussions around resilient transport technologies, data-driven navigation, and the role of communication systems in shaping smart mobility. Her expertise and collaborative spirit enriched the RIIS research community and reinforced our mission to lead innovation in resilient and intelligent infrastructure.

We gratefully acknowledge the support of the Australian Research Council in enabling these impactful exchanges and advancing research that benefits the broader Australian community.



Associate Professor Mathilde Morvan from the Pascal Institute & POLYTECH Clermont, France

The RIIS Hub was thrilled to host Associate Professor Mathilde Morvan from the Pascal Institute & POLYTECH Clermont, France an internationally recognised expert in soil-related structural impacts. Her visit brought fresh momentum to RIIS's mission to safeguard homes and infrastructure from the devastating effects of natural disasters.

A/Prof Morvan's seminar offered compelling insights into the hidden dangers of swelling and shrinking soils phenomena that can wreak havoc on buildings, especially detached houses. Her research focuses on developing affordable, accessible diagnostic tools to predict soil behaviour and inform smarter planning decisions. These innovations are particularly relevant to RIIS's Theme 3 research, which explores thermo-plasticity models and predictive techniques to detect flaws and prevent failure.

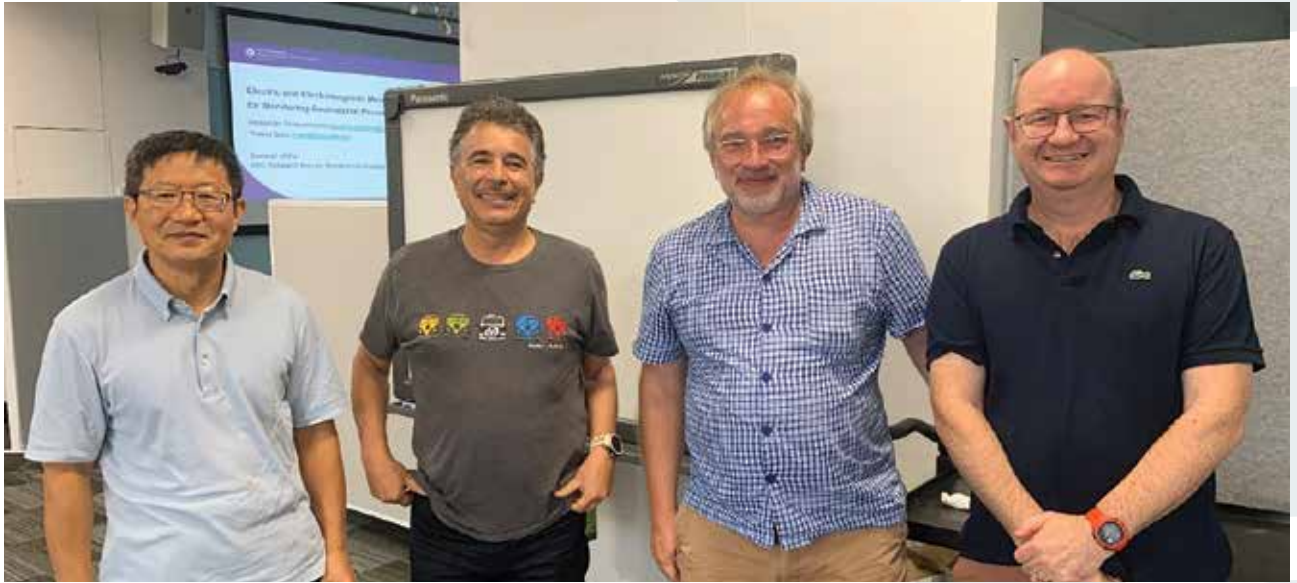
During her visit, A/Prof Morvan shared alarming statistics from France, where soil shrinkage and swelling rank just behind floods in terms of damage costs. She emphasised the urgent need for cost-effective soil characterisation

methods to support due diligence in construction and urban planning. Her current project proposes monitoring individual homes in high-risk areas to generate reliable data that can guide future resilience strategies.

The visit sparked rich collaboration with RIIS researchers, including one-on-one sessions to explore data sharing and joint research opportunities. RIIS Hub Director Professor Nasser Khalili remarked, "We want to make flood-affected dwellings as 'safe as houses' and ensure Aussies and their homes are better prepared to weather future storms."

This impactful exchange was made possible through NSW Chief Scientist RAAP funding and reflects RIIS's commitment to global knowledge-sharing and innovation. With contributions from UNSW, Western Sydney University, and QUT, Theme 3 continues to push boundaries in predictive modelling, simulation, and AI-driven infrastructure resilience.





Left to right - Professor Chongmin Song, Professor Nasser Khalili, Professor Alex Scheuermann, Professor Adrian Russell

Prof Alexander Scheuermann from University of Queensland's School of Civil Engineering

In February 2025, the RIIS Hub was honoured to host Professor Alexander Scheuermann from the University of Queensland's School of Civil Engineering. A leading figure in geotechnical and environmental engineering, Prof Scheuermann delivered a seminar titled *Electric and Electromagnetic Measuring Techniques for Monitoring Geomaterial Processes*, which drew strong interest from RIIS researchers and students.

Prof Scheuermann leads the GeoSystems Group at UQ, a research collective focused on investigating complex multiphysical processes in porous media, particularly under unsaturated conditions. His academic journey began at the Karlsruhe Institute of Technology in Germany, where he completed his Habilitation Thesis on Spatial Time Domain Reflectometry (Spatial TDR) a technique now widely applied in geohydraulics and geomechanics.

His visit to RIIS was a valuable opportunity to exchange ideas on infrastructure health monitoring and predictive maintenance. Prof Scheuermann's contributions to the advancement of Spatial TDR earned him the

Queensland Smart Futures Fellowship in 2012, and his continued excellence in research was recognised with an ARC Future Fellowship in 2018 for his work on erosion. He also serves as Editor of *Acta Geotechnica* and Associate Editor of the *Journal of Geophysics and Engineering*.

The RIIS Hub greatly benefited from Prof Scheuermann's insights and expertise, and his visit exemplifies our commitment to fostering collaboration with world-class researchers to drive innovation in resilient infrastructure systems.



OUR CELEBRATIONS

LAUNCH

RIIS Hub Launch: A Bold Step into the Future of Infrastructure Innovation



In April 2023, the ARC Research Hub for Resilient and Intelligent Infrastructure Systems (RIIS) was officially launched at UNSW Sydney, marking a transformative milestone in Australia's infrastructure research landscape. This dynamic event brought together leading minds from academia, industry, and government to celebrate the beginning of a new era one defined by collaboration, innovation, and impact.

The launch was more than ceremonial it was a declaration of intent. With 16 work packages already in motion, the Hub is rapidly advancing its mission to revolutionise how infrastructure is designed, monitored, and maintained. The Australian Research Council's Deputy CEO, Dr Richard Johnson, heralded the Hub as a catalyst for deploying cutting-edge technologies



to tackle real-world challenges in urban infrastructure, transport, water, energy, and resource management.

UNSW's Deputy Vice-Chancellor, Professor Nicholas Fisk, captured the spirit of the moment, describing the Hub as emblematic of a paradigm shift in research moving from siloed investigations to interdisciplinary, team-based innovation. Scientia Professor Nasser Khalili, RIIS Hub Director, echoed this vision, emphasizing the Hub's ambition to harness digital technologies to reshape infrastructure systems in ways previously unimaginable.

The RIIS Hub launch was not just a celebration, it was a call to action. It signalled the beginning of a bold journey to co-create resilient, intelligent, and sustainable infrastructure solutions that will benefit Australia and the world for generations to come.

PROJECT PRESENTATIONS AND UPDATES

Team Connectedness: Igniting Ideas and Strengthening Collaboration



In March 2024, the RIIS Hub marked a pivotal moment in its journey with the first in-person team gathering in Sydney—a celebration of progress, partnership, and possibility. This milestone event brought together researchers, industry partners, and collaborators from across Australia, representing UNSW Sydney, University of Western Sydney, QUT, and the University of Melbourne. The energy in the room was electric, as the Hub's growing community came together to share updates, spark new ideas, and deepen engagement.

With over 90% of RIIS projects underway or about to launch, the day showcased the Hub's momentum and ambition. Professor Nasser Khalili opened the event with a powerful message: "We are firing on all cylinders," highlighting the contributions of 22 world-leading professors, 4 postdoctoral fellows, 19 PhD



students, and a host of industry collaborators. The event underscored the Hub's commitment to solving real-world infrastructure challenges from predictive maintenance and corrosion control to smart energy systems and digital twinning.

The format was dynamic and engaging, with speed-dating style project presentations, lively Q&A sessions, and thought-provoking provocations from leaders like Professor Wei Gao, who urged the team to embrace “brave ideas” that will shape the future. Industry partner James Linke from GEOAI shared a compelling case study on airport infrastructure, exemplifying the “win-win-win” potential of RIIS collaborations.

From nano sensors and AI-driven modelling to robotics and enhanced imagery, the event revealed the cutting-edge technologies driving RIIS research. It also reinforced the power of connectedness how face-to-face dialogue, shared purpose, and mutual respect can accelerate innovation and unlock transformative solutions for Australia's infrastructure future.

2024 RIIS END-OF-YEAR WRAP-UP

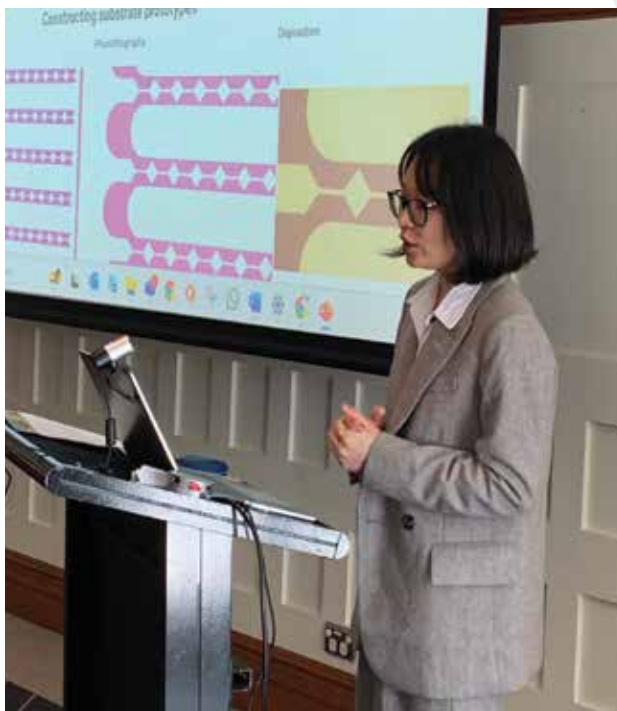
Celebrating Progress, Inspiring Possibility



The RIIS Hub closed out 2024 with a vibrant celebration at the Coogee Bay Hotel, Sydney, an event that brought together researchers, industry leaders, and collaborators to reflect on a year of innovation and to ignite fresh momentum for 2025.

The day opened with a warm welcome from the Hub's Director and Deputy Director, who shared key research milestones and strategic directions. Garry Mostyn, Chair of the Industry Advisory Board, offered a compelling vision for the Hub's future, stating, *"The RIIS Hub is uniquely positioned to lead transformative infrastructure research. Our strength lies in the depth of collaboration and the boldness of our ideas."*

Industry partners took centre stage, sharing cutting-edge innovations and insights. Dr Govinda Pandey, CEO of Rockfield Technologies, emphasised the importance of practical impact:



“We’re not just solving technical problems we’re shaping the infrastructure of tomorrow with solutions that are scalable, sustainable, and smart.” James Linke, CTO and CFO of GeoAI, highlighted the power of data-driven collaboration: *“RIIS is a nexus for intelligent infrastructure. The synergy between research and industry here is unlike anything I’ve seen—it’s where ideas become action.”*

Huadong Mo, speaking on behalf of Dr James Ciyu Qin from Advanced United Technologies, added: *“Process optimisation and system intelligence are no longer future goals they’re happening now, and RIIS is at the forefront.”*

The afternoon featured the RIIS poster competition, convened by Arman Khoshghalb, where HDR students showcased pioneering research in predictive maintenance, digital twins, and adaptive systems. The event concluded with a relaxed dinner, fostering deeper connections and sparking new collaborations.

This wrap-up wasn’t just a celebration it was a reaffirmation of RIIS’s mission to lead with purpose, innovate with impact, and build resilient, intelligent infrastructure for Australia and beyond.

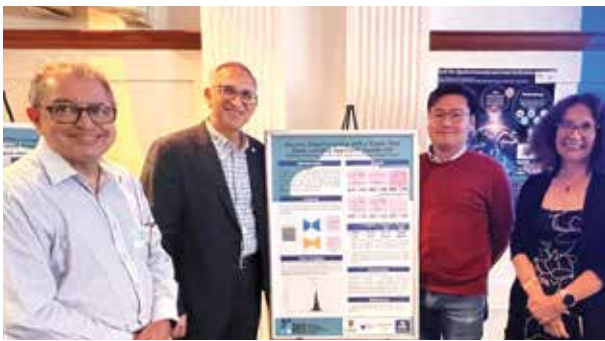
Hub End-of-Year Poster Competition

RIIS Hub students participated in a Poster Competition during our end-of-year workshop. Judges evaluated entries based on two key criteria:

- Effective communication when describing their research: Actively engaging with the audience, inviting questions and spurring discussions
- Poster is visually attractive, well-balanced with text and graphics enhancing the understanding of the content

WINNING POSTER

Vladislav Alekseev



Research Poster Title

Seismic Data Denoising with a Single-Shot Deep Learning Approach: Double-DIP

Research Insight

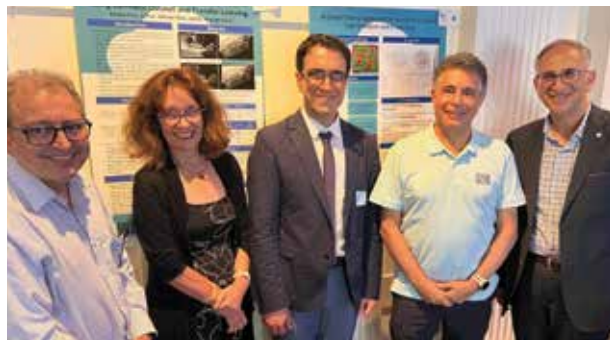
Denoising is an essential step in seismic data interpretation. We proposed a novel deep learning approach where one neural network predicts the clean signal while another estimates the original noise. This single-shot method requires no additional training data, working directly on a single image. It effectively preserves structural information while achieving superior denoising performance.

Industry partner on this project

Kumul Petroleum

RUNNER UP POSTER

Amir Fila



Research Poster Title

A Graph Theory Approach for Aerial Point Cloud Segmentation and Processing

Research Insight

The majority of research on aerial point cloud data segmentation uses the term 'complexity' vaguely by abstractly assigning higher complexity to those point cloud datasets with higher computation requirements. As part of my PhD research, I aim to provide a mathematical approach, leveraging graph theory and Laplacian matrix analysis, to address the complexity elements inherent in aerial LiDAR captures. This approach will serve as a valuable tool for understanding complexity across different sections of a given point cloud dataset, ultimately aiding in noise recognition and boundary detection processes.

Industry partner on this project

Woolpert Asia-Pacific

Congratulations to both students on their outstanding work. We also extend our sincere thanks to our industry partners for supporting RIIS Hub research, practical research application, and educational opportunities.

INTERNATIONAL WOMEN'S DAY AT UNSW

Championing Change in STEM



Kim Delbaere
Professor



Dani Alexander
CEO



Yan Jiao
Professor



Maria Rashidi
Senior Lecturer



Kim van Schooten
Research Fellow



Elise Elkington
PhD Student

IWD24 Count her in: Celebrating Women in STEMM

Friday, 8 March 2024 | 1:00 - 2:00 PM



The RIIS Hub at UNSW celebrated International Women's Day 2024 with a powerful online panel discussion featuring five inspiring women in STEM, including RIIS Hub Chief Investigator, Dr. Maria Rashidi (Senior Lecturer, ARC Research Hub for Resilient and Intelligent Infrastructure Systems, UNSW). Held via Zoom, the event brought together other ARC program participants to share their experiences, insights, and hopes for a more equitable future in science and engineering.

The panel included:

- Dani Alexander – Chief Executive Officer, UNSW Energy Institute
- Prof Yan Jiao – ARC Centre of Excellence for Carbon Science and Innovation, UNSW
- Dr Kim van Schooten – ARC Research Hub for Connected Sensors for Health, UNSW and NeuRA
- Elise Elkington – ARC Training Centre for the Global Hydrogen Economy, UNSW

Dr. Rashidi delivered a compelling message about resilience, empowerment, and advocacy. "I'm very passionate about my work," she

shared, urging attendees to "not let anyone blow the flame out within you." She highlighted the pressing challenges women still face globally from gender pay gaps and workplace civility to intersectional barriers involving race, disability, and access to education. Her call to action emphasised the role of men and allies in advocating for gender equality, mentoring women in STEM, and creating opportunities for skill and professional development.

Maria also spoke candidly about the importance of self-care and setting boundaries, especially for working mothers. She encouraged women to prioritize their mental and physical wellbeing and to let go of "mum's guilt." Her advice to connect with mentors and peers resonated deeply, reinforcing the value of community and support in overcoming challenges and excelling in technical fields.

The event was a celebration of progress and a reminder of the work still ahead. Through voices like Dr. Rashidi's, UNSW continues to champion change and foster a more inclusive STEM environment.

National Science Week 2024 at RIIS Hub



National Science Week 2024 was a vibrant celebration of scientific innovation and collaboration, highlighting the transformative potential of science in infrastructure, engineering, and advanced manufacturing. At the RIIS Hub, the event provided a platform to showcase the groundbreaking research of our higher degree researchers (HDRs), including Sana Shahoveisi and Adel Ahmadi. Sana's work focuses on preventing dam failures through advanced fracture modelling in porous media, while Adel is developing safer geotechnical solutions for foundations and tunnels by exploring the dynamic properties of soils under hydraulic stress.

This year's celebration also marked the continued success of RIIS Hub's collaborative model, uniting researchers from UNSW, the University of Melbourne, QUT, and Western Sydney University with 18 industry partners. As Professor Nasser Khalili noted, this partnership is central to our mission of addressing Australia's infrastructure challenges through science-driven solutions. National Science Week not only honoured the contributions of Australian scientists but also inspired public engagement and youth interest in STEM fields, reinforcing the importance of science in shaping a resilient future.

EMPOWERING FUTURE LEADERS

RIIS HDR Student Achievements and Career-Building Highlights

2024 was a standout year for RIIS Hub's Higher Degree Research (HDR) students, marked by a series of inspiring achievements, career-building opportunities, and national recognition. The Hub's commitment to nurturing emerging talent was on full display through its support of student participation in the prestigious Information Resilience PhD School, hosted by the ARC Training Centre for Information Resilience (CIRES) in Brisbane and Melbourne.

Ensiyeh Javaherian Pour, another rising star from the University of Melbourne, was honoured as runner-up in the 3MT competition and a Group Competition winner in Data Science and Analytics. Her work on integrating spatial and graph databases for 3D utility data management is pushing the boundaries of digital twin technology.

Samah Said, a UNSW student, was awarded a CIRES Travel Grant to attend the PhD School, enabling him to engage in mentorship,



This immersive event brought together PhD candidates from across Australia to explore cutting-edge data science practices, build peer networks, and engage with world-leading researchers. RIIS Hub students shone brightly, with Masoud Kamali earning the *People's Choice Award* for his compelling Three-Minute Thesis (3MT) presentation on *Zero-shot 3D Object Detection in complex industrial environments*. Masoud also secured runner-up in the Data Literacy Competition, showcasing his deep expertise in spatial digital twins and AI-driven modelling.

knowledge exchange, and collaborative research discussions with global experts such as Prof Gao Cong and Prof Jenny Zhang.

These achievements reflect the RIIS Hub's vibrant research culture one that empowers students to lead, innovate, and connect. Through competitions, workshops, and national events, RIIS HDR researchers are not only advancing infrastructure science but also building the skills and networks needed to shape the future of resilient and intelligent systems.

CELEBRATING INDUSTRY COLLABORATION

RIIS Hub and Covaris Internship Success



In a shining example of academia-industry synergy, RIIS Hub HDR student Saeed Khalaj from QUT embarked on a transformative three-month internship with Sydney-based engineering consultancy Covaris. This opportunity, made possible through RIIS Hub's partnership with The Asset Institute, immersed Saeed in real-world data science challenges, where he applied machine learning and Bayesian statistics to tackle asset management issues in renewable energy and transport systems. His work not only advanced his PhD research on railway surface degradation but also contributed directly to Covaris' client solutions proving the power of collaborative innovation.

The internship exemplifies RIIS Hub's commitment to delivering hands-on, high-impact training experiences for emerging researchers. As RIIS Director Professor Nasser Khalili noted, "There is real value to being immersed in a working environment... it allows students to stretch their experiences and apply their knowledge to solve asset management and infrastructure problems." Covaris Managing Director Bob Platfoot echoed this sentiment, celebrating the company's mission to empower organisations through asset management excellence. This partnership is a testament to the Hub's vision: connecting brilliant minds with industry to co-create resilient, intelligent infrastructure solutions for Australia and beyond.

ACADEMIC EXCELLENCE

RIIS Leaders Honoured on the Global Stage

2024 was a year of exceptional recognition for RIIS Hub's academic leadership, with multiple Chief Investigators receiving prestigious awards and appointments that underscore the Hub's global influence and intellectual strength.

Professor Sisi Zlatanova



SHARP Professor and Head of GRID at UNSW Sydney, was elected a lifelong Fellow of the International Society for Photogrammetry and Remote Sensing

(ISPRS)—a rare honour bestowed for sustained excellence in spatial information science. She also assumed the presidency of ISPRS Technical Commission IV, positioning Australia as a global host for the 2024 symposium.

Scientia Professor Nasser Khalili



RIIS Hub Director, was elected Fellow of the Australian Academy of Technological Sciences and Engineering (ATSE), joining

a distinguished cohort of leaders shaping Australia's technology-powered future. His pioneering work in geotechnical engineering and infrastructure resilience continues to influence national policy and engineering practice.

Professor Abbas Rajabifard



RIIS Deputy Director, received dual honours: he was appointed to the United Nations Global Geospatial Knowledge and Innovation Centre's

International Advisory Committee, contributing to the advancement of global geospatial frameworks for sustainable development; and he was awarded a prestigious Fellowship by the International Research Centre of Big Data for Sustainable Development Goals (CBAS), recognising his leadership in harnessing data and technology to support the UN SDGs.

Associate Professor Jagannath Aryal

was honoured with the Asia Pacific Spatial Excellence Award for Educational Development, celebrating his transformative contributions to geospatial education and research across Oceania. His leadership in Earth observation and spatial analytics continues to empower the next generation of infrastructure innovators.

These accolades reflect the calibre of RIIS Hub's academic community visionary, globally connected, and deeply committed to advancing resilient and intelligent infrastructure systems. Their achievements not only elevate the Hub's reputation but also inspire the broader research ecosystem to pursue excellence with purpose.

Dr Mo Huadong Wins IEEE SMC Early Career Award



At the 2024 IEEE International Conference on Systems, Man, and Cybernetics (IEEE SMC), Dr Mo Huadong, a PhD graduate from

the Department of Systems Engineering, was honoured with the prestigious IEEE SMC Early Career Award. This accolade recognises his outstanding contributions to the theory and industrial applications of resilient systems engineering a field critical to ensuring robust and adaptive technological infrastructures in complex environments.

Dr Mo's work stands out for its innovative approach to designing systems that can withstand and recover from disruptions, a capability increasingly vital across industries ranging from manufacturing to smart cities. His research has bridged theoretical advancements with practical implementations, demonstrating the real-world impact of resilient systems engineering.

Currently serving as a Senior Lecturer at the University of New South Wales, Dr Mo is the sole recipient of the IEEE SMC Early Career Award in 2024. This singular recognition highlights the exceptional calibre of his achievements and positions him as a leading figure in the global systems engineering community.

Global Appointments for RIIS Hub Partner Investigator - Prof. Dr. Zaffar Sadiq Mohamed-Ghouse



In 2025, the RIIS Hub celebrated the international recognition of Prof. Dr. Zaffar Sadiq Mohamed-Ghouse, Director of Geospatial Advisory

and Innovation at Woolpert Asia-Pacific and a valued RIIS Hub Partner Investigator. Prof. Zaffar was appointed Chair of the United Nations Global Geospatial Information Management – Geospatial Societies (UN-GGIM:GS) and Vice Chair of the Open Geospatial Consortium (OGC) Board of Directors.

These prestigious appointments highlight Prof. Zaffar's leadership and influence in shaping global geospatial policy and innovation. As Chair of UN-GGIM:GS, he will lead a coalition of geospatial societies that advises the United Nations on matters of geospatial information management. His role will help strengthen international collaboration and ensure geospatial data continues to support sustainable development and infrastructure resilience.

In his position as Vice Chair of the OGC Board, Prof. Zaffar will contribute to the organisation's governance and strategic direction, promoting financial sustainability and member-focused leadership. His vision aligns closely with the RIIS Hub's mission to advance intelligent infrastructure through cutting-edge geospatial research and partnerships.

The RIIS Hub is proud to acknowledge Prof. Zaffar's achievements and celebrates his continued contributions to both the Hub and the global geospatial community.

OUR PUBLICATIONS



Publications to Date

Over the past four years, the RIIS Hub has emerged as a powerhouse of innovation, driving transformative research across structural engineering, materials science, geospatial intelligence, and digital infrastructure. With a prolific output of high-impact journal articles, conference papers, and book chapters, the Hub has consistently pushed the boundaries of knowledge and application.

From pioneering virtual modelling techniques for dynamic fracture analysis and structural reliability, to integrating machine learning for uncertainty quantification and defect prediction, RIIS researchers have tackled some of the most complex challenges in engineering. Their work on advanced composite materials, smart sensors, and digital twins has laid the groundwork for safer, more resilient infrastructure particularly in mining, transport, and civil construction sectors.

The Hub's contributions to geospatial AI and smart city development have also been remarkable. Innovations in GNSS-based ionospheric noise estimation, underground utility mapping, and CityGML-based graph data models reflect a deep commitment to shaping the future of urban environments. Meanwhile, the integration of IoT-Bayes fusion and real-time risk monitoring systems demonstrates RIIS's leadership in environmental safety and operational intelligence.

With a strong emphasis on sustainability, the Hub has advanced research in embodied carbon optimisation, fire resilience, and long-term corrosion modelling. These efforts not only support Australia's infrastructure needs but also align with global goals for climate-conscious engineering.

In short, RIIS Hub's publication record from 2022 to 2025 showcases a vibrant, interdisciplinary research ecosystem that is not only solving today's problems but actively designing tomorrow's solutions.

YEAR	ITEM TYPE	TITLE	DOI
2022	Journal Article	A numerically efficient framework in failure mode evaluation of a wind turbine tower under cyclones	10.1016/j.marstruc.2022.103303
2023	Journal Article	Experimental-numerical-virtual (ENV) modelling technique for composite structure against low velocity impacts	10.1016/j.engstruct.2022.115488
2023	Journal Article	Nonlinear dynamic stability analysis of imperfect architected cellular sandwich plate under impact loading	10.1007/s10409-022-22333-x
2023	Journal Article	Quantification of Structural Defects Using Pixel Level Spatial Information from Photogrammetry †	10.3390/s23135878
2023	Journal Article	Virtual modelling technique for geometric-material nonlinear dynamics of structures	10.1016/j.strusafe.2022.102284
2023	Journal Article	Robust numerical solution for assessing corrosion of reinforced concrete structures under external power supply	10.1016/j.engstruct.2023.116724
2023	Journal Article	Recent Advances in Integrating 1D Nanomaterials into Chemiresistive Gas Sensor Devices	10.1002/admt.202202038
2023	Journal Article	Virtual modelling integrated phase field method for dynamic fracture analysis	10.1016/j.ijmecsci.2023.108372
2023	Journal Article	Nonlinear dynamic stability analysis of axial impact loaded structures via the nonlocal strain gradient theory	10.1016/j.apm.2022.10.029
2023	Journal Article	Advanced virtual model assisted most probable point capturing method for engineering structures	10.1016/j.res.2023.109527
2023	Journal Article	Nonlinear dynamic analysis of the functionally graded graphene platelets reinforced porous plate under moving mass	10.1016/j.tws.2022.110363
2023	Journal Article	Past, current and future trends and challenges in non-deterministic fracture mechanics: A review	10.1016/j.cma.2023.116102
2023	Journal Article	Gas nanosensors for health and safety applications in mining	10.1039/d3na00507k
2024	Journal Article	Nonlinear dynamic analysis of the graphene platelets reinforced porous plate with magneto-electro-elastic sheets subjected to impact load	10.1007/s11071-023-09093-3
2024	Journal Article	Liquid Metal-Enabled Galvanic Electrocrystallization of Charge-Transfer Complexes	10.1021/acs.cgd.4c01212
2024	Journal Article	Microelectrode-enabled Electrocrystallization of Cobalt TCNQ Complex for Gas Sensing	10.1002/celc.202300826
2024	Journal Article	Phase-field modelling of dynamic hydraulic fracturing in porous media using a strain-based crack width formulation	10.1016/j.cma.2024.117113
2024	Journal Article	Optimizing Stone Mastic Asphalt mix design with TGAN-enhanced surrogate models	10.1016/j.conbuildmat.2024.138863
2024	Journal Article	Stochastic bandgap optimization for multiscale elastic metamaterials with manufacturing imperfections	10.1016/j.ijmecsci.2024.109035
2024	Journal Article	Chloride ingress analysis on alkali-activated slag concrete: A validated modelling framework for long-term assessment	10.1016/j.job.2024.109867

YEAR	ITEM TYPE	TITLE	DOI
2024	Journal Article	Machine learning aided uncertainty quantification for engineering structures involving material-geometric randomness and data imperfection	10.1016/j.cma.2024.116868
2024	Journal Article	Virtual model-aided reliability analysis considering material and geometrical uncertainties for elastic metamaterials	10.1016/j.ymsp.2024.111199
2024	Journal Article	Virtual modelling aided safety assessment for ductile structures against high-velocity impact	10.1016/j.engstruct.2023.117373
2024	Journal Article	Advancements in 3D digital model generation for digital twins in industrial environments: Knowledge gaps and future directions	10.1016/j.aei.2024.102929
2024	Journal Article	Full-field experiment-aided virtual modelling framework for inverse-based stochastic prediction of structures with elastoplasticity	10.1016/j.cma.2024.117284
2024	Journal Article	Reliability and sustainability integrated design optimization for engineering structures with active machine learning technique	10.1016/j.jobe.2024.111480
2024	Journal Article	Smoothing and approximation of grassland fire loading data for engineering structures by Capped Extended Support Vector Regression	10.1016/j.engstruct.2024.118848
2024	Journal Article	Virtual modelling based fragility assessment of structures under bushfire propagation	10.1016/j.res.2024.110000
2024	Journal Article	Additive manufacturing error quantification on stability of composite sandwich plates with lattice-cores through machine learning technique	10.1016/j.compstruct.2023.117645
2024	Journal Article	Understanding the nanoscale phenomena of nucleation and crystal growth in electrodeposition	10.1039/d4nr02389g
2024	Journal Article	Dynamic crack propagation in elasto-plastic materials using phase-field virtual modelling method	10.1016/j.cma.2024.117160
2024	Journal Article	Monitoring slope stabilization of a reactivated landslide in the Three Gorges Reservoir Region (China) with multi-source satellite SAR and optical datasets	10.1007/s10346-024-02289-7
2024	Journal Article	Sustainable Design Optimization for Engineering Structures Considering Embodied Carbon	10.14912/jsmcwm.t3rincs2024.0_41
2024	Journal Article	A numerical framework for modelling chloride transportation in alkali-activated slag concrete	10.14912/jsmcwm.t3rincs2024.0_39
2025	Journal Article	Ionospheric process noise estimation via single-receiver GNSS data	10.1080/14498596.2024.2396394
2025	Journal Article	Quantitative evaluation of bolt pre-load using coda wave interferometry and nonlinear coda wave interferometry: a comparative study	10.1007/s13349-024-00815-8
2025	Journal Article	Ground penetrating radar-based automated defect identification of bridge decks: a hybrid approach	10.1007/s13349-024-00895-6
2025	Journal Article	Physical-informed random field technique for virtual modelling based building probabilistic vulnerability assessment	10.1016/j.strusafe.2025.102595
2025	Journal Article	Stochastic fracture and fatigue analysis in elasto-plastic materials via virtual modelling techniques	10.1016/j.cma.2025.117997

YEAR	ITEM TYPE	TITLE	DOI
2025	Journal Article	IoT-Bayes fusion: Advancing real-time environmental safety risk monitoring in underground mining and construction	10.1016/j.res.2024.110760
2025	Journal Article	Application of self-sensing concrete sensors for bridge monitoring – A review of recent developments, challenges, and future prospects	10.1016/j.measurement.2024.116543
2025	Journal Article	Advancements in vibration-based energy harvesting systems for bridges: A literature and systematic review	10.1016/j.rineng.2025.104622
2025	Journal Article	Computational fluid dynamics -informed virtual safety assessment of steel-framed structure with fire-induced ductile failure	10.1016/j.res.2025.110918
2025	Journal Article	Transformer-based time-series GAN for data augmentation in bridge digital twins	10.1016/j.autcon.2025.106208
2025	Journal Article	Bridge health monitoring through series analysis: Full-scale validation on a Truss Bridge	10.1016/j.engstruct.2025.120516
2025	Journal Article	Nonlinear dynamic analysis of geometrically imperfect multi-direction functionally graded graphene platelet reinforced composite plates with magneto-electro-elastic sheets subjected to blast load	10.1016/j.apm.2025.115957
2025	Journal Article	Fusion-based graph neural networks for synergistic underwater image enhancement	10.1016/j.inffus.2024.102857
2025	Journal Article	Developing a CityGML-based Graph Data Model for Utility Infrastructure in Smart Cities	10.5194/isprs-annals-x-g-2025-405-2025
2025	Journal Article	Image-to-Point Cloud Registration using Camera Motion Generation and Monocular Depth Estimation	10.5194/isprs-annals-x-g-2025-453-2025
2025	Journal Article	Quantitative evaluation of bolt pre-load using coda wave interferometry and nonlinear coda wave interferometry: a comparative study	10.1007/s13349-024-00815-8
2025	Journal Article	Ionospheric process noise estimation via single-receiver GNSS data	10.1080/14498596.2024.2396394
2025	Journal Article	Development of a decision support framework for timber bridge remediation	10.1016/j.rineng.2025.106917
2025	Journal Article	Ballasted Railway Track–Bridge Transition Zone Monitoring Methods: Recent Developments, Challenges, and Prospects	10.1061/JPEODX.PVENG-1608
2025	Journal Article	Electro-chemo-physical analysis for long-term reinforcement corrosion within the reactive system of concrete	10.1016/j.cemconcomp.2024.105846
2025	Journal Article	Integrated Energy Management for Operational Cost Optimization in Community Microgrids	10.48550/ARXIV.2503.08009
2025	Journal Article	IoT-Bayes fusion: Advancing real-time environmental safety risk monitoring in underground mining and construction	10.1016/j.res.2024.110760
2025	Journal Article	Multilabel Learning With ViT for Building Footprint Extraction From Off-Nadir Aerial Images	10.1109/LGRS.2025.3532589

YEAR	ITEM TYPE	TITLE	DOI
2025	Journal Article	Peak Load Mitigation Using Battery Energy Storage Systems for a Regional Distribution Network	10.1109/TIA.2025.3605311
2025	Journal Article	Polymorphic uncertainty field quantification in structural analysis with machine learning assistance	10.1016/j.ymsp.2024.112273
2025	Journal Article	Proposal of a Fire Loading Curve for Engineering Structures Subjected to Grassland Fires	10.1061/JSENDH.STENG-14299
2025	Journal Article	Quantifying the basin dynamics of the Proterozoic Carrara Sub-basin to understand the assembly and evolution of the Australian continent	10.1016/j.gr.2025.06.009
2025	Journal Article	Rail surface defect prediction and inspection planning using limited maintenance data – a hierarchical Bayesian approach	10.1080/23248378.2025.2508803
2025	Journal Article	Review and assessment of 3D spatial data models for managing underground utility networks	10.1016/j.tust.2024.106219
2025	Journal Article	Semi-supervised bridge indirect structural health monitoring using Isolation Distributional Kernels	10.1016/j.ymsp.2024.112296
2025	Journal Article	Stratya2D: Enhancing kinematic backstripping with image-based 2D horizon integration	10.1016/j.cageo.2025.106056

Year	Item Type	Title	DOI
2024	Conference Paper	Hardware-Based Time Synchronization for a Multi-Sensor System	10.1109/IROS58592.2024.10802693
2024	Conference Paper	Developing a Workflow for Transforming BIM Models into Immersive Virtual Reality Experiences	10.5194/isprs-archives-XLVIII-4-2024-485-2024
2024	Conference Paper	Seeing Text in the Dark: Algorithm and Benchmark	10.1145/3664647.3680728
2024	Conference Paper	Vector Field-based Autonomous Navigation in a Tunnel-like Environment	10.1109/IPIN62893.2024.10786181
2024	Conference Paper	A Method for Battery SoH Estimation Based on K-means and LightGBM algorithm	10.1109/SRSE63568.2024.10772504

YEAR	ITEM TYPE	TITLE
2023	Book Section	Machine learning-aided stochastic static analysis of functionally graded porous plates
2023	Book Section	Machine learning aided stochastic free vibration analysis of functionally graded porous plates
2024	Book Section	Machine learning aided stochastic free vibration analysis of functionally graded porous plates
2024	Book Section	Machine learning-aided stochastic static analysis of functionally graded porous plates



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... the R&D ecosystem was in the midst of a paradigm shift towards collaborative, interdisciplinary, team efforts, compared to older models of sole trader discipline-specific investigator research. The Hub really is an exemplar of this high-tech transformative approach to translate research with industry to commercial outcomes, which through its success will go on to benefit this nation and beyond.

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