SENSING, MINING AND WATER WORKSHOP
29 November 2021
Outcomes

NSSN
NSW Smart Sensing Network

NSSN Grand Challenge Fund

The NSW Smart Sensing Network (NSSN) is calling on research, industry and government stakeholders to form collaborative proposals and apply for funding under round two of the *NSSN Grand Challenges Fund*. The applications are open now and close on **21 February 2022.**

Grants of up to $100,000 per project will support the development of R&D projects that link industry or government partners with NSSN member universities to translate world-class research into impactful smart sensing solutions, either through commercialisation or operationalisation.

The Fund has been established to promote the development of innovative, collaborative research projects that advance smart sensing solutions to the six NSSN Grand Challenges: ageing, bushfires, COVID-19, water; plus the two new Grand Challenges introduced this year: mining, and smart places and buildings.

The Grand Challenges have been selected for the important role smart sensing can play in responding to the issue and where technological innovation holds the promise to change the game. They have also been selected for the NSSN's unique ability to mobilise the world-class R&D capability across our member universities in partnership with industry and government for practical, impactful outcomes.

Eligibility criteria:
- **Leadership:** be led by an NSSN member university.
- **Collaboration:** involve a minimum of two NSSN member universities (incl. the lead).
- **Partnership:** partner with at least one industry or government partner.
- **Co-investment**: attract cash co-investment from industry/government partners at least equal to the requested amount.

Visit the Grand Challenge Fund page for more details and how to apply.

Sensing, Mining and Water

Advanced sensing and data analytics can help improve our understanding of the relationship between mining and water

Water is critical for life; our towns and cities, farms and industrial processes require reliable sources of water. Mining is critical in providing the materials to build and power our world.

The workshop considered six key themes.: Baseline Measurement, Desalination, Dewatering, Operational Water Use, Tailings and End Use and Reuse.

Baseline Measurement

Gravity, quantum, LiDAR, hyperspectral imaging, weather data, advanced exploration, geological surveys, satellites, process optimisation.

Desalination

Ground cover, surface water flow, ground water basin profile, dam levels, extraction data, water quality, molecular sensing.
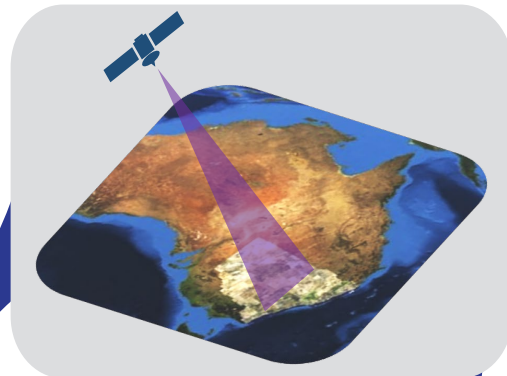
Dewatering

Process sensing, optimisation algorithms, sensing pump and cyclone wear, microscopy, quantum imaging.

Operational water use

Level sensors, flow meters, artificial intelligence and machine learning, asset management.

Tailings

Underground robotics, strata management, understanding fissures and cracks, understanding uncertainty of system parameters, human and community factors.

End use and reuse

Analysis of aeriel and satellite imagery, advanced chemistry, data analytics, efficiency, economy and circularity.

Participants in the workshop worked in Breakout groups to come up firstly a series of Challenge Statements, then a series of Solution Statements for each of the six themes.

Breakout 1: Baseline Measurement

Industry presentation
Tyler Tinkler, GHD
Baseline measurement for mine closure

Academic presentation
Lucy Marshall, UNSW
Baseline measurements: Uncertainty

Challenge Statements

#1. How can we better understand hydro-conductivity within and surrounding mines?

#2. How can we safeguard our environment?

#3. Can we reliably respond to anomalies reported by data analytics without physical sensing? How do we know when predictive models of mine water are accurate?

Solution statements

#1. We can use a combination of remote sensing, geophysics, groundwater monitoring to better understand recharge rates and other changes over time.

#2. We can create a digital twin that models the real mine situation and train it. The better knowledge we have of the impacts of mining on surrounding aquifers and catchments, with agreed measurement parameters for compliance and regulation, then we can ensure mining has minimal impact on surrounding hydrology.

#3. We can learn from other industries, such as transport, that are making important operational decisions, based on data alone.

Breakout participants

Ayu Saraswati, NSSN
Ben Eggleton, University of Sydney
David Nguyen, N2N AI Pty Ltd
Fabienne D'hautefeuille, DPIE Water
Hung Thai, UTS
Ismet Canbulat, UNSW
Judith Dawes, Macquarie University
Kyle Hardman, Nomad Atomics
Lan Fu, ANU
Liang Wang, The University of Newcastle
Lucy Marshall, UNSW
Nuwan Munasinghe, UTS
Rob Sharp, ANU
Simit Raval, UNSW Sydney
Tyler Tinkler, GHD

Contact NSSN if you'd like to connect.

Breakout 2: Dewatering

Industry presentation
Kevin Tasker, Xylem
Decision intelligence in mining

Academic presentation
Prof Martijn De Sterke, The University of Sydney
Atmospheric Water Capture from the atmosphere

Challenge Statements

#1. How do we improve our understanding of the interaction of groundwater and dewatering systems, considering changing climatic conditions over different time frames?

#2. How can we improve our understanding of asset performance to help managers and operators make better decisions to optimise performance and asset life?

#3. How can we totally eradicate environmental contamination as a result of mine dewatering?

Solution statements

#1. We can use new breakthroughs in predictive modelling, using information provided by sensing a broader number of parameters at different time and special scales, and augmented by external data sets such as GIS, meteorological data, and those from other operations.

#2. There are a number of analytical tools to assist asset life and performance including Bayesian methods, uncertainly analysis, digital twins, and designing-in sensor requirements.

#3. We can use real time in-line and online information, sensed in the mining equipment, in the rock and in the surrounding environment.

Breakout participants

Clare Sykes, Larkin Sykes
David Cookson, ANSTO
Kevin Tasker, Xylem
Martijn De Sterke, University of Sydney
Norman Ballard, Senquip
Ron Johan, NSSN
Sarath Kodagoda, UTS
Sarvesh Kumar Singh, UNSW
Sureka Thiruchittampalam, UNSW
Kevin Tasker, Xylem
Gavin Paul, UTS

Contact NSSN if you'd like to connect.

Breakout 3: Desalination

Industry presentation
Garth Walter, Sacyr Water Australia
Sensing, Mining & Water - Smart Desalination

Academic presentation
Professor Grant Hose, Macquarie University
Desalination and mine water impacts

Challenge Statements

#1. What does a carbon neutral desalination plant look like? How can we better understand carbon usage over lifecycle of the plant?

#2. How might we manage and dispose brine effectively?

#3. How might we monitor output water so that it meets a variety of uses including production needs and a return to the environment?

Solution statements

#1. We can look to the latest research in measuring in real time and predicting future carbon usage and ambient levels, including tracking energy usage, additive consumption and efficiency.

#2. We can consider developments in the understanding of circular economies and treat brine as a resource to be reused in other industries. We can adopt technologies from other industries including health, agriculture, and town planning.

#3. The sensing technology exists to rapidly assess dozens of parameters to assure fit for purpose water at functional endpoints including bio-sensors for specific species, machine learning and artificial intelligence, and replicating high-cost sensors with low-cost alternatives.

Breakout Participants

Aimran Akhtar, Carbonix
Bevan McLachlan, McLanahan Corporation
Dammika Vitanage, Sydney Water
Grant Hose, Macquarie University
Patrick Kluth, ANU
Paul Scobie, University of Newcastle
Peter Morrisey, Hunter Net
Peter Runcie, NSSN
Pramith Priyananda, University of Sydney
Quinn Ollivier, WaterNSW
Stuart Woolnough, UTS Group Australia

Contact NSSN if you'd like to connect.

Breakout 4: Operational Water Use

Industry presentation
Kevin Barber, Jord International
An introduction to Jord

Academic presentation
Dr Stephen Northey, Institute for Sustainable Futures, University of Technology Sydney
Understanding the context and drivers of mine-site operational water use

Challenge Statements

#1. How to provide economically viable, ubiquitous, intrinsically safe monitoring solution covering large distances and areas.

#2. How to optimise water use in a flotation circuit based on smart measurement and data driven modelling.

#3. How might we use sensors so that we can better characterise mining activities in extreme conditions?

Solution Statements

#1. We can use Power-over-Fiber (PoF) sensing networks that overcome wireless options which are not intrinsically safe and don't work underground.

#2. Flowsheet redesign to include fast sensing with machine learning will enable online mineral characterisation including rheology, particle size and grade of ore with water usage, which in turn leads to data informed flexible control.

#3. We can consider surrogate measurements, low cost sensors and better analysis of historical data to have full situational awareness of operational parameters, including extreme environments where physical contact is impossible.

Breakout Participants

Francois Ladouceur, UNSW
Julien Epps, UNSW
Ram Vaidyanathan, NSSN
Stephen Northey, UTS
Subhasish Mitra, University of Newcastle
Tomonori Hu, NSSN
Yansong Shen, UNSW

Contact NSSN if you'd like to connect.

Breakout 5: Tailings

Industry presentation
Bev Kubat, Amira Global
The Mining Value Chain

Academic presentation
Professor John Close,
Australian National University
Gravity mapping/monitoring of leaks from tailings dams with atomic sensors

Challenge Statements

#2. How can we prevent any more catastrophic tailings dam failures, incentivising differing stakeholders in ways that link risks, costs and benefits?

#2. How do we avoid generating tailings in the first place?

#3. How can we better utilise tailings to create value.

Solution statements

#1. The sensing of tailings dams, being a high risk aspect of a high value activity, with catastrophic consequences in the event of failure, should be at the absolute global forefront of sensing technology and data analytics. There should be complete understanding of the physical status of all tailings dams, with predictions into the future allowing for all possible scenarios. This requires bold investment in technology like quantum sensing, gravitation sensing, fusing different data sources, real time seismic and strain monitoring, and the most advanced predictive and analytical computational techniques for mapping the underground.

#2. We can avoid generating tailings in the first place, if more effort goes into all upstream aspects of mining operations which should be sensed and analysed for a arrange of physical, chemical and operational parameters and mitigating process investigated (e.g. deep mining and blockcaving) that give the best value alternative to production of tailings.

#3. New and exciting thinking coming from circular economics should be utilized to prevent, reduce, reuse, reprocess, repurpose, recycle and recover the materials that go into tailings, with disposal a last resort to be avoided where possible.

Breakout Participants

Bev Kubat, AMIRA Global
Brett Bussell, Perilya Broken Hill Ltd
Chris Beal, NextOre
Ivan Chua, NSSN
John Close, ANU
Nader Issa, Terra15
Serkan Saydam, UNSW
Ross Atherton, CARBONIX

Contact NSSN if you'd like to connect.

Breakout 6: End Use and Reuse

Industry presentation
Dr Burkhard Seifert, OZ Minerals
Innovation Creates Value

Academic presentation
Dr Mariam Darestani,
Western Sydney University
Turning mining waste to high performance inorganic materials for construction and mining applications

Challenge Statements

#1. How might we develop value-added products from water containing minerals, salts and organics?

#2. How might the fundamental properties of wastewater be utilised to advantage?

#3. How might we use lower grades of water?

Solution statements

#1. Real-time in-situ sensing of water including the development of development of molecule specific electrochemical, ionic, conductive and quartz crystal microbalance sensors to identify minerals in water

#2. Develop better ionic sensing to optimize the treatment technologies that are unique for individual mining operations and recycle, reuse and repurpose wastewater, including harnessing osmotic energy.

#3. Use available in-situ sensors with artificial intelligence and automated systems to immediately identify water resources that can be used, reused, reprocessed and only discharge water when quality is benign to the surrounding environment.

Breakout Participants

Binghao Li, UNSW
Gilad Francis, The University of Sydney
Graham Chase, CEEMCo
Mariam Darestani, Western Sydney University
Nicholas Haskins, NSSN
Qinghua Zeng, WSU
Sathaa Sathasivan, WSU
Sean Downes, ANU
Yun Liu, ANU
Burkhard Seifert, OZ Minerals
Subhasish Mitra, University of Newcastle

Contact NSSN if you'd like to connect.

Keynotes and Facilitators

Dr Susan Pond AM
Chair of the NSSN Board

Biography

Dr Pond is a senior leader in business & academia, recognised for her national & international contributions in medicine, science & technology. She is a Fellow of the Royal Society of NSW (FRSN), the Australian Academy of Technology & Engineering (FTSE), and The Australian Academy of Health & Medical Sciences (FAHMS). Dr Pond has chaired the NSSN Board since its establishment in 2016.

In April 2021, Dr Pond was elected as President of the Royal Society of NSW. In this role, she leads the oldest learned society in the Southern Hemisphere and works to amplify the Society's impact as a leading, independent source of knowledge and debate.

Dr Pond was Director of The University of Sydney Nano Institute from 2017 - 2018. This multidisciplinary institute advances the University's discipline strength in quantum science, nanophotonics, nanoscale materials & molecular nanoscience while also studying the potential impacts of these technologies beyond science, medicine and engineering into the humanities and social sciences.

Professor Hugh Durrant-Whyte
NSW Chief Scientist & Engineer and Natural Resources Commissioner

Biography

Professor Durrant-Whyte manages the Office of the NSW Chief Scientist & Engineer (OCSE), which has four distinct functions: Independent Advice, Research Support, Industry Development, and Science Outreach and Education.

Previously, Hugh was Chief Scientific Advisor to the UK Ministry of Defence. He was a Professor and ARC Federation Fellow at the University of Sydney, CEO of National ICT Australia (NICTA), and Director of the ARC Centre of Excellence for Autonomous Systems and of the Australian Centre for Field Robotics (ACFR).

Hugh is a world-leading authority on machine learning and robotics, and applications in areas including cargo handling, mining and defence. He has published over 300 research papers, graduated over 70 PhD students, and has won numerous awards and prizes for his work, including being named 2010 NSW Scientist of the Year and 2008 Engineers Australia NSW Engineer of the Year.

John James Fennell B Ec, CA, AICD
CEO
International Copper Association Australia

Biography

John Fennell is the CEO of the International Copper Association Australia Ltd which is the pre-eminent marketing and technology development body for the copper industry in Oceania and which is closely aligned with the global International Copper Association (ICA) and the Copper Alliance.

ICAA's members represent a majority of Australasia's copper production and the largest copper and copper alloy fabricators. ICAA's status as a not-for-profit trade association provides its members with a credible independent advocate to address challenges faced by the collective industry

Prior to his role with the ICAA, John owned and operated a mid size manufacturing company in the automotive industry and prior to that worked with Price Waterhouse in the accounting and management consulting fields.

Professor Alan Broadfoot
Executive Director, Newcastle Institute for Energy and Resources
University of Newcastle

Biography

Professor Alan Broadfoot has been the Executive Director of the Newcastle Institute for Energy and Resources (NIER) at the University of Newcastle since 2010. At NIER, Alan leads an ambitious agenda linking industry and academia for transformational research in energy, resources, food and water. Alan holds a Doctor of Philosophy, Master of Engineering and Bachelor of Electrical Engineering (Honours) from the University of Newcastle. An Electrical Engineer in various roles from 1985, Alan joined electrical design and manufacturing company, Ampcontrol in 1991 and held senior management positions, including Managing Director and CEO from 2005–2010. He is a Fellow of the Institution of Engineers Australia and was Chair of the Australian Industry Group Hunter Manufacturing Council from 2004 –2009. He is a Graduate of the Australian Institute of Company Directors, a Fellow of The Royal Society of NSW, Chair of the NSW Energy and Resources Knowledge Hub and Board member of TUNRA and CRC CARE.

Professor Ben Eggleton
NSSN Co-Director
The University of Sydney

Biography

Professor Benjamin Eggleton is the Director of The University of Sydney Nano Institute. He also serves as co-Director of the NSW Smart Sensing Network (NSSN). Eggleton was the founding Director of the Institute of Photonics and Optical Science (IPOS) at the University of Sydney and served as Director from 2009-2018. He was previously an ARC Laureate Fellow and an ARC Federation Fellow twice and was founding Director of the ARC Centre of Excellence for Ultrahigh bandwidth Devices for Optical Systems (CUDOS) from 2003-2017.

Eggleton is the author or coauthor of more than 510 journal publications, including Nature Photonics, Nature Physics, Nature Communications, Physical Review Letters and Optica and over 200 invited presentations. His journal papers have been cited 25,000 times according to webofscience with an h-number of 79 (109 in google scholar). Eggleton is a Fellow of the Australian Academy of Science (AAS), the Australian Academy of Technology and Engineering (**ATSE**), the Optical Society of America, SPIE and IEEE. He is Editor-in-Chief of APL Photonics.

Professor Julien Epps
NSSN Co-Director
UNSW Sydney

Biography

Professor Julien Epps is Head of the School of Electrical Engineering and Telecommunications at UNSW Sydney and was appointed Co-Director of the NSW Smart Sensing Network (NSSN) in July 2021. Professor Epps is also a Contributed Researcher at Data61, CSIRO, and a Scientific Advisor for Sonde Health. Prior to joining UNSW, Professor Epps held research appointments with the A*STAR Institute for Infocomm Research, National ICT Australia and Motorola Labs.

Professor Epps is the author or co-author of around 250 journal articles, conference publications and patents related to sensor signal processing. His work has been cited more than 9,000 times (Google Scholar). He has given multiple keynote and invited tutorial presentations to several major international conferences. He is currently serving as an Associate Editor for the IEEE Transactions on Affective Computing.

Dr Don McCallum
Theme Leader Industrial Futures
NSSN

Biography

Don is the Theme Leader for Industrial Futures, responsible for engagement with key government and industry stakeholders. Don was one of the original employees of the NSSN and instrumental in its early development. He has led successful projects for the NSSN in water, recycling, mining and more.

Prior to the NSSN, Don spent six years in Africa and the Middle-East in project coordination, strategy and technology in extreme environments and emergencies for the NGO Medecines Sans Frontiers. Don has a wealth of experience working with manufacturing and advanced materials for mines, refineries and laboratories. He started 3D printing Braille in 1999, the topic of his PhD. He spent a few years with the high tech printing firm, Xaar, in Cambridge, UK, before moving on to bio-engineering at the University of Wollongong.

Clare Sykes
Managing Director
LarkinSykes Pty Ltd

Biography

Clare is an engineer and innovation strategist with expertise in resource sector value chains and is skilled in practical pathway identification to create sustainable enterprise and resilient regions.

She has worked in both private and public enterprise including International Markets development at METS Ignited and NSW Govt Trade and Investment.
More recently through her consulting firm she has worked on various multi stakeholder initiatives including resource technology roadmaps, challenge based innovation programs, assisting firms with strategy development and funding opportunities, and supporting industry cluster programs.
She is a mining engineer (UNSW), Graduate of AICD, holds a Graduate Dip. of Applied Finance, is a Churchill Fellow, and has undertaken the Women in Leadership Australia Advanced Leadership Program.

She serves on the Advisory Board of the Newcastle Institute of Energy and Resources (NIER) and is Chair of Resources NSW an initiative of the NSW Energy and Resources Knowledge Hub.

Industry Breakout Presenters

Tyler Tinkler
Senior Water Engineer
GHD – Northern NSW

Baseline measurement & mass water balance

Biography

Tyler has six years' experience in water resources assessment, design and management, particularly in water management in mining sector. Tyler has a thorough understanding of the regulatory requirements and implications for water management infrastructure, including water security, licensing, metalliferous and tailings dams. This experience has been developed through the entire project life cycle from specialist impact assessments, feasibility studies and detailed design, through to management plans and compliance reporting.

Garth Walter
Managing Director
Sacry Water Australia

Desalination

Biography

Garth Walter is Managing Director for Sacyr Water Australia and has worked in many different aspects of the Water Industry since completing his Engineering Degree. He has more than 25 years' experience in public and private organisations and held senior roles across mining, contracting, infrastructure development and utilities. Garth is also part owner of The Walter Group Australia & Red Gully Wines; and enjoys supporting the community through the Australian Water Association, Workpower, Cottesloe Surf Club and FHWA.

Kevin Tasker
Xylem Water Solutions Australia

Dewatering

About Xylem

Xylem, a leading global water technology company dedicated to solving the world's most challenging water issues, is the leading global provider of efficient, innovative and sustainable water technologies improving the way water is used, managed, conserved and re-used. Our international team is unified in a common purpose: creating advanced technology and other trusted solutions to solve the world's water challenges. We are committed to creating an organization of inclusion and diversity, where everyone feels involved, respected, valued and connected, and where everyone is free to bring their authentic selves and ideas.

Kevin Barber
Jord International

Operational Water Use

About Jord International

Jord International is an Australian owned company that designs, manufactures, commissions, and services custom-engineered process equipment, modular skids, and turnkey plants for the oil & gas, chemical, power, food, industrial and mining sectors.

Bev Kubat
Manager Collaborations
Amira Global

Tailings

Biography

Bev's career as a mining engineer spans 20 years across multiple commodities and countries. Her roles have traversed from technical specialist to people leader. She has a passion for understanding the psychology that drives organisational behaviour and strives to unlock people's potential by considering the complexity of the individual in relation to the dynamics of the group . Her current involvement in the deployment of the Amira Global Tailings Program has convinced her that technical solutions only unlock one element of the challenges facing the mining industry. Taking a systemic approach to understanding organisational culture and group dynamics ensures that innovation strategies are successfully implemented.

Dr Burkhard Seifert
Oz Minerals

End Use and Reuse

Biography

Burkhard has over 15 years' experience in working across the business development sector, specifically in the mining and energy industry. Burkhard currently works as Entrepreneur - Transformation at OZ Minerals. This role has a focus on strategic partnerships, revenue and growth, general management, international business development, and on working with start-ups. He has a passion for international collaboration, technology and business strategy.

Academic Breakout Presenters

Lucy Marshall
University of New South Wales
Baseline Measurement

Biography

Professor Lucy Marshall is Director of the Water Research Centre at the University of New South Wales (UNSW) in Sydney. Lucy completed her undergraduate, Master's and PhD degrees at UNSW before moving to Montana State University in 2006, where she worked at the interface of engineering and environmental science in quantifying uncertainty in hydrologic and environmental systems. She returned to UNSW as an Australian Research Council Future Fellow in 2013. Her technical expertise is in hydrologic modelling, model optimization, and quantification of uncertainty in water resources analysis. She is a leading Australian expert on the assessment of uncertainty in water resources models, and more specifically in Bayesian methods for model inference.

Grant Hose
Macquarie University

Desalination

Biography

Professor Grant Hose is an aquatic ecologist and ecotoxicologist at Macquarie University. His research examines the response of aquatic invertebrate and microbial communities to environmental contaminants, and uses environmental genomics for assessing change in ecosystem health and condition. He has worked on mine and mine water issues for over 20 years as a consultant, regulator and researcher, and understands the complexities of mine waters and their management.

Martijn De Sterke
University of Sydney

Dewatering
Atmospheric water capture from the atmosphere (ACWA)—
atmospheric water capture by passive means

Biography

Martijn de Sterke received an engineering degree from the University of Delft in the Netherlands and a PhD from the University of Rochester in the USA. After a postdoctoral work at the University of Toronto in Canada, he joined the University of Sydney, where he is now a Professor in Physics. He has a background in optics and the modelling of optical materials.

Dr Stephen Northey
University of Technology Sydney

Operational Water Use
Understanding the context and drivers of mine-site operational water use

Biography

Dr Stephen Northey is a research fellow at the University of Technology Sydney, where he focuses on environmental benchmarking of mineral production systems and developing long-term scenarios for metal supply. In prior roles at CSIRO and Monash University, Stephen developed water footprint, life cycle assessment and techno-economic assessments of technologies being developed for mineral processing and metal production, and conducted extensive work to understand the contextual water scarcity and climate risks facing mining.

Professor John Close
Australian National University

Tailings

Biography

John completed his PhD in physics at the University of California at Berkeley in 1991. He was a postdoctoral fellow at the University of Washington in Seattle from 1992 to 1995 and an Alexander von Humboldt Fellow at the Max Planck Institute in Göttingen, Germany from 1995 to 1998. John returned to Australia and took up a position as Queen Elizabeth II Fellow at the ANU in 2000. John was promoted to Professor of Physics in 2008. He was Deputy Director of the Research School of Physics from 2012-2016, elected member of ANU council from 2012 to 2014, member of the ARC Panel of Experts from 2014-2016, and is currently Head of ANU Defence Engagement and Head of the Quantum Sensors Group in the Department of Quantum Science.

John was the 2020 recipient of the Australian Defence Industry Award for Academic of the Year, and the recipient of the 2020 Australian Defence Industry Award for Excellence for his work on quantum sensors and more generally for driving collaboration between defence and academia.

Dr Mariam Darestani
Western Sydney University

End Use and Reuse
Turning mining waste to high performance inorganic materials for construction and mining applications

Biography

Dr Darestani is a material engineer passionate about the environment and focused on developing new materials and products for sustainable use of resources, especially water. She is a fellow of Higher Education Academy (HEA) and STEM Champion of 21C program at WSU working on development of interdisciplinary specialisation courses for undergraduate students.

Dr Darestani first joined WSU in 2018 as a visiting academic from Queensland University of Technology (QUT). She has been working full time at WSU since 2020. At QUT, she was an Advance Queensland Research Fellow (2016-2020) and her research was sponsored by an industry partner and QLD Ministry of Fishery and Agriculture. Before joining QUT in 2019 in 2014, Dr. Darestani worked at University of Technology Sydney (UTS) and the University of Sydney as a postdoctoral research fellow (2012-2014). She worked as an R&D engineer before joining UTS and after finishing her PhD in Chemical Engineering at University of Sydney.

Partners

The NSSN thanks the support of all partners in the planning and running of the Sensing, Mining and Water Workshop

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