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Research Conversazione

Faculty of Engineering

14 August 2019

THE UNIVERSITY OF
SYDNEY
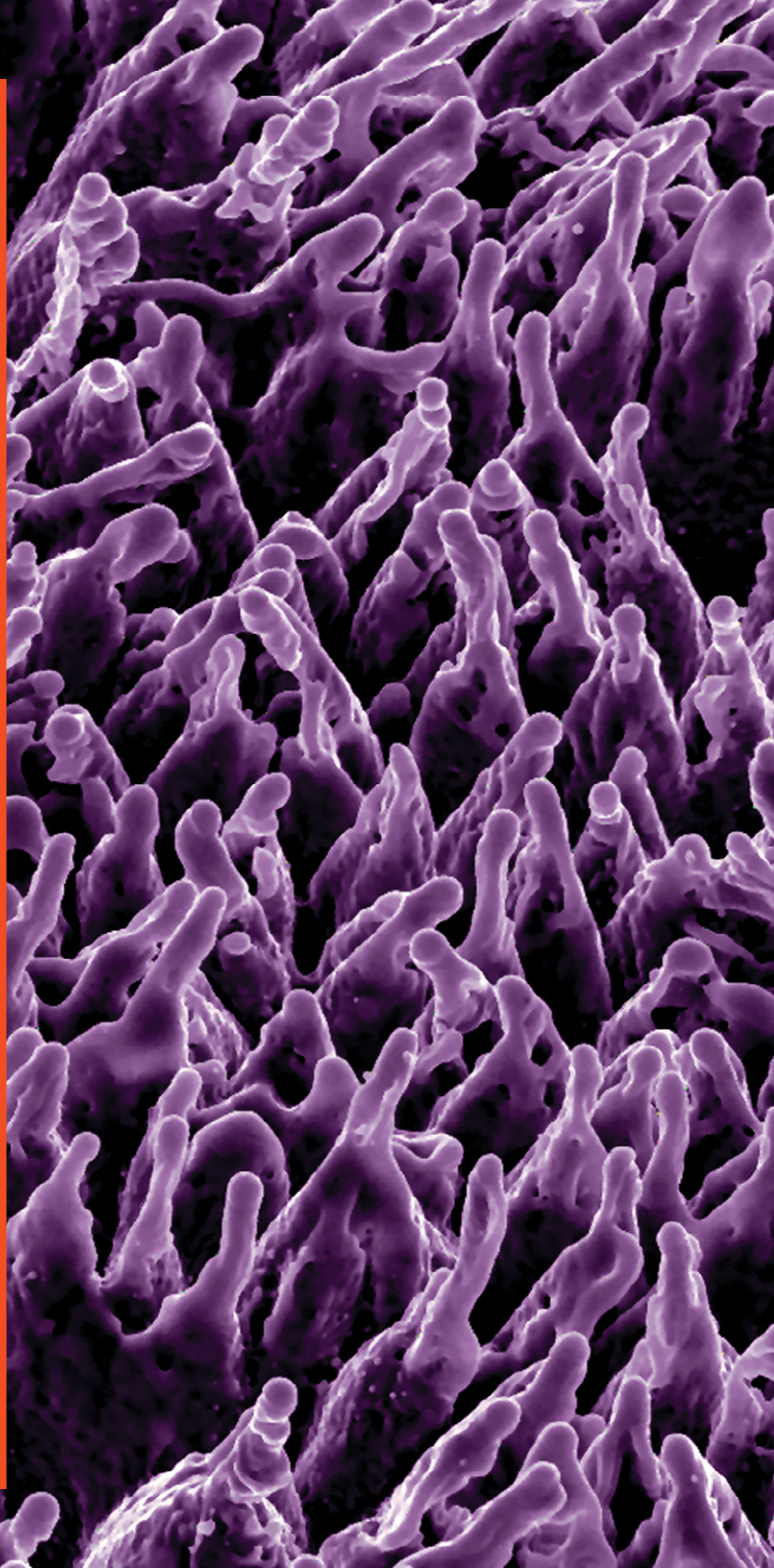
Welcome
Research Conversazione 2019

With interactive displays and bite-sized research presentations, this event offers a unique opportunity to engage with our talented minds, meet our experts and forge relationships for future collaboration.

We are proud to showcase some of the latest research undertaken by staff and students from the Faculty of Engineering across a wide range of disciplines, encompassing:

- biomedical engineering and technologies
- data science and computer engineering
- food products, process and supply chain
- the Internet of Things
- robotics and intelligent systems
- complex systems
- energy, resources and the environment
- infrastructure and transport.

We hope you enjoy this diverse presentation of research and the opportunity to connect with some of our dynamic students and staff.

Presentations
2.30–3pm

How _well_ will I hear?	Greg Watkins
Key-value stores – making sense of data in an instant	Oana Balmau
The gut microbiome: a path to personalised medicine	Juan Pablo Molina Ortiz
Developing a novel cardiac ablation modality for atrial fibrillation	Luke Zhao
Data science revolution	Roman Marchant
Milk for infants: more than just food	Katherine Blackshaw
Data visualisation and analytics in healthcare	Euijoon Ahn

Research displays
3–4.30pm

Biomedical engineering and technologies

Developing a novel cardiac ablation modality for atrial fibrillation
Luke Zhao

This research uses a novel ablation technique combining electroporation and electrolysis in a single pulse (E2) using lower voltages for the treatment of atrial fibrillation.

Supervisor: Professor Alistair McEwan

Prediction of cochlear implant speech intelligibility
Greg Watkins

This research investigates output signal to noise ratio as a predictor of speech intelligibility for cochlear implant recipients which could lead to improved hearing outcomes due to more productive research and personalised device configurations.

Supervisor: Professor Gregg Suaning and Dr Brett Swanson

Atmospheric pressure plasma jets in 3D bioprinters for surface engineering of biomaterials
Oliver Lotz

This research is developing a new localised surface modification tool for bioprinters. The tool will allow greater biocompatibility and design flexibility for the fabrication of advanced healthcare devices.

Supervisor: Professor Marcela Bilek and Dr Behnam Akhavan

Plasma immersion ion implantation of porous materials: platform for mesenchymal stem cell expansion
Anyu Zhang

This project aims to develop a scaffold-based platform for mesenchymal stem cell (MSC) expansion using plasma immersion ion implantation technology. This new surface engineering approach contributes to lowering the cost of MSC therapy for treatment of diseases including diabetes and osteoarthritis.

Supervisor: Professor Marcela Bilek and Dr Behnam Akhavan

Epileptic seizure detection and forecasting ecosystems
Nhan Truong

This research focuses on how to effectively and reliably detect and predict seizure onset based on electroencephalogram patterns.

Supervisor: Dr Omid Kavehei

Data visualisation and analytics in healthcare
Euijoon Ahn

This research develops a visual analytic tool that can effectively understand the demographic and the clinical profile of frequent presenters to emergency departments. The use of the visual analytic tool highlights gaps in interventions and identifies new opportunities for better health planning and outcomes.

Supervisor: Associate Professor Jinman Kim

Development of novel measurements of infants as indicators of lifelong health
Jian (Carter) Sun

This project aims to improve the survival rate and lifelong health of preterm and term infants by developing a non-invasive, portable, and easy-to-use device that measures infant body fat percentage against consumed nutrition.

Supervisor: Professor Alistair McEwan

Proactive management of skin cancer
MetaSense Pty Ltd (University of Sydney-based start-up)
Dr Reza Behi

MetaSense has developed a portable/wearable device (SafeSpot) and its software platform, to help minimise the likelihood of skin cancer.

Data science and computer engineering

Active signal strength prediction based on deep learning
Peng Cheng

Development of a data-driven channel modelling framework for 5G using advances in deep learning, resulting in accurate signal strength prediction for digital television bands.

Supervisor: Professor Branka Vucetic

High speed machine learning for field programmable gate arrays
Siddhartha

Using machine learning to develop high-speed, robust and reliable computer systems for radio-frequency communication applications.

Supervisor: Professor Philip Leong

Data protection techniques for emerging applications
Vera Miloslavskaya

This project aims to solve the problem of efficient data transmission for emerging applications by developing a systematic approach to data protection under ultra-low delay requirements.

Supervisor: Professor Branka Vucetic and Professor Yonghui Li

Building high-performance, scalable key-value stores
Oana Balmau

This research focuses on designing high-performance key-value stores. Key-value store systems are wide-spread in cloud applications like online shopping and advertising. They are flexible, scalable and able to efficiently handle big data.

Supervisor: Professor Willy Zwaenepoel

Centre for Translational Data Science's cross- and trans-disciplinary scientific discoveries
Philippe Morere and Rafael Oliveira

CTDS aims to unleash the power of data by developing methodologies for data fusion, modelling and decision making under uncertainty with expertise in intelligent and autonomous systems, personalised medicine and modelling of complex physical, life and social systems.

Supervisor: Professor Sally Cripps and Professor Fabio Ramos

Food products, process and supply chain
The gut microbiome: a path to personalised medicine
Juan Pablo Molina Ortiz

This research developed a simulation to quantify gut microbiome competition and symbiosis dynamics, tracing metabolite production and consumption. It uses computational approaches to highlight how different dietary components modulate the microbiome to inform personalised interventions.

Supervisor: Professor Fariba Dehghani, Associate Professor Andrew Holmes Dr Dale McClure and Dr Mark Read

Flexible sensors
The Centre for Excellence in Advanced Food Enginomics

The Centre for Excellence in Advanced Food Enginomics is developing various types of flexible sensors to be incorporated in packaging. The sensors are designed to respond to different analytes generated during food spoilage via colour change or an electrical signal.

Supervisor: Professor Fariba Dehghani

Microalgal production of omega-3 fatty acids
Wenjia Gu

This research explores the potential of replacing conventional sources of omega-3 like fatty fish and krill with plant sources, such as microalgae. Microalgae offers a promising alternative to these traditional sources as global fish stocks are exploited and depleted.

Supervisor: Associate Professor John Kavanagh, Dr Dale McClure

Gut microbiome modulation with dietary carbohydrates
Alison Luk

Experimental diets containing different carbohydrate types, protein and energy content were investigated for their effects on the gut microbiome, to formulate strategies to develop healthier foods and target consumers most likely to benefit from them.

Supervisor: Associate Professor Andrew Holmes

Internet of Things

Trust management in crowdsourced IoT services
Mohammed Bahutair

This research focuses on developing a trust management framework that attempts to address trust challenges that arise in Internet of Things crowdsourcing environments

Supervisor: Professor Athman Bouguettaya

Cognitive amplifier for IoT
Bing Huang

This research presents a cognitive amplifier framework to augment parts of an Internet of Things, with cognitive capabilities to improve life conveniences.

Supervisor: Professor Athman Bouguettaya

Composing Drone-as-a-Service for delivery
Babar Shahzaad

This research aims to develop an efficient drone service selection and composition infrastructure to create new opportunities for innovative, faster, and cheaper delivery solutions.

Supervisor: Professor Athman Bougettaya

Deep learning in telecommunications: learn from digital twins
Rui Dong and Changyang She

This project develops a deep learning framework to learn network management schemes from a digital twin to enable rapid decision-making in real-time.

Supervisors: Professor Yonghui Li and Professor Branka Vucetic

IoT and Telecommunications
Zhouyou Gu, Wenhao Zhang

This research aims to develop a programmable scheduler for Internet of Things network operators. This will allow operators to dynamically re-configure the network according to IoT traffic demands to provision various IoT services, creating new revenue streams.

Supervisor: Dr Wibowo Hardjawana and Professor Branka Vucetic

Robotics and intelligent systems
Multi-vehicle trajectory optimisation
Philip Gun

This project applies motion planning techniques optimising the trajectories of multiple cooperative vehicles utilising the same road network to improve, safety, efficiency and cost.

Supervisor: Dr Andrew Hill

Semantic segmentation for autonomous driving
Wei Zhou

This research applies an existing trained semantic segmentation model to a local environment to achieve real-time performance under different conditions and applying the algorithm in an electric vehicle.

Supervisor: Professor Eduardo Nebot and Dr Stewart Worrall

Complex systems

The effects of paediatric vaccination behaviours in SIR-network model
Sheryl Le Chang

This research investigates the driving factors of vaccination behaviours and the complex interactions between disease dynamics and travelling patterns using a susceptible-infected-recovered network model to increase individual awareness and maintain high vaccination coverage, protecting communities.

Supervisor: Professor Mikhail Prokopenko

The effects of urbanisation on epidemics in Australia
Nathan Harding

This research examines key differences in the global prevalence and spatial spread of infection in Australia and assess the viability of multiple vaccination strategies to understand how urbanisation is affecting society's overall susceptibility to widespread contagion.

Supervisor: Professor Mikhail Prokopenko

Modelling neuronal networks from brain recordings
Leonardo Novelli

This project co-develops new efficient algorithms to study complex systems such as the brain and financial markets.

Supervisor: Dr Joseph Lizier

Immersive Learning Laboratory: projects by civil engineering academics
Manisha Devrapalli, Arvindan Kaviraj, Yash Mehta

Using virtual reality in teaching provides students with an immersive learning experience and understanding of structures and environments where it otherwise might be unsafe to visit.

Supervisor: Dr Benjy Marks and Dr Jacqueline Thomas

Network influence on adoption of environmentally sustainable agricultural practice and communication: a case study of cocoa farmers in Sulawesi, Indonesia
Abner Yalu

This research investigates the use of various network measures and their role in influencing adoption of environmentally sustainable agriculture practice and extension services in Sulawesi, Indonesia.

Supervisor: Dr Petr Matous

Energy, resources and the environment
Degradation of recalcitrant pollutants in industrial wastewater using electrochemical process
Julia Ciarlini Junger Soares

This research focuses on the process of removing hard-to-treat pollutants in effluents from various industries using electricity to improve water quality and converting aqueous pollutants into valuable chemical compounds.

Supervisor: Dr Alejandro Montoya

Design and control of power electronic converters for future sustainable renewable energy-based Direct Current (DC) nanogrid
Waqas Hassan

This research aims to design, develop and control novel power electronic converters to efficiently and reliably interface renewable energy sources into DC nanogrid at low cost.

Supervisor: Associate Professor Weidong Xiao

Crowdsourcing energy as a service
Abdallah Lakhdari

This research proposes a platform for crowdsourcing energy as a service from wearables. The source of energy is kinetic movement or heat from the human body. Internet of Things users' energy requirements are satisfied through crowdsourced energy services creating a green computing environment.

Supervisor: Professor Athman Bouguettaya

Hydrogel electrolytes for flexible and rechargeable Zn-air batteries
Zengxia Pei, Xinshi Zhang

This research aims to develop functional polymeric hydrogels as solid-state electrolytes for flexible and rechargeable zinc-air batteries, which can be one of the most promising power sources for various flexible electronics.

Supervisor: Professor Yuan Chen

Infrastructure and transport

Terraces, towers, and trains: modelling the growth of Sydney
Bahman Lahoorpoor

The objective of this research is to characterise railway network evolution over a long period of time and evaluate their projected impacts on land use development.

Supervisor: Professor David Levinson

Access across Australia
Hao Wu

This research measures accessibility, the ease of reaching valued destinations, for eight major Australian cities, covering 70% of resident workers and employment opportunities nationally.

Supervisor: Professor David Levinson

Development of a novel shear connector for timber concrete composite beams
Rory McDougall, Lachlan Reid Charlie Wiseman

This research will develop shear connectors that connect engineered timber and concrete beams to allow these beams to act together as one. It aims to make timber-concrete composite beams a viable construction technology, offering comparable strength to existing techniques with significantly lower environmental footprint.

Supervisor: Dr Ali Hadigheh

Circular economy for fibre reinforced polymer composites
Yaning Wei

The objective of this research is to reshape our fundamental knowledge of carbon fibre reinforced polymer (CFRP) composite recycling via a closed-loop approach (recycling, reproduction, and reuse). This project will provide exciting new technologies and insights, and enables us to make CFRP recycling a reality.

Supervisor: Dr Ali Hadigheh

Factors and solutions to thermal desiccation of geosynthetic clay liners
Bowei Yu

This research examines the desiccation of geosynthetic clay liners which is widely used as hydraulic and contaminant barriers. It offers design solutions to ensure greater durability of composite liner systems keeping subsoils and groundwater from contaminants.

Supervisor: Professor David Airey, Professor Abbas El-Zein

Rolling dynamic compaction (RDC)
Yuxiao Li

This research investigates the behaviour of dry unsaturated sand and soil mixtures under cyclic load. It analyses the increase in soil density and particle movements to understand the effects of water content and soil types on the use of impact compaction.

Supervisor: Professor David Airey

For more information
Keiran Passmore
Manager Education Engagement and
Partner Relationship Manager, Faculty of Engineering
+61 2 9351 5768
keiran.passmore@sydney.edu.au
sydney.edu.au/engineering

facebook.com/Engineering.Sydney.University
@Eng_IT_Sydney
@engineering_sydney

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