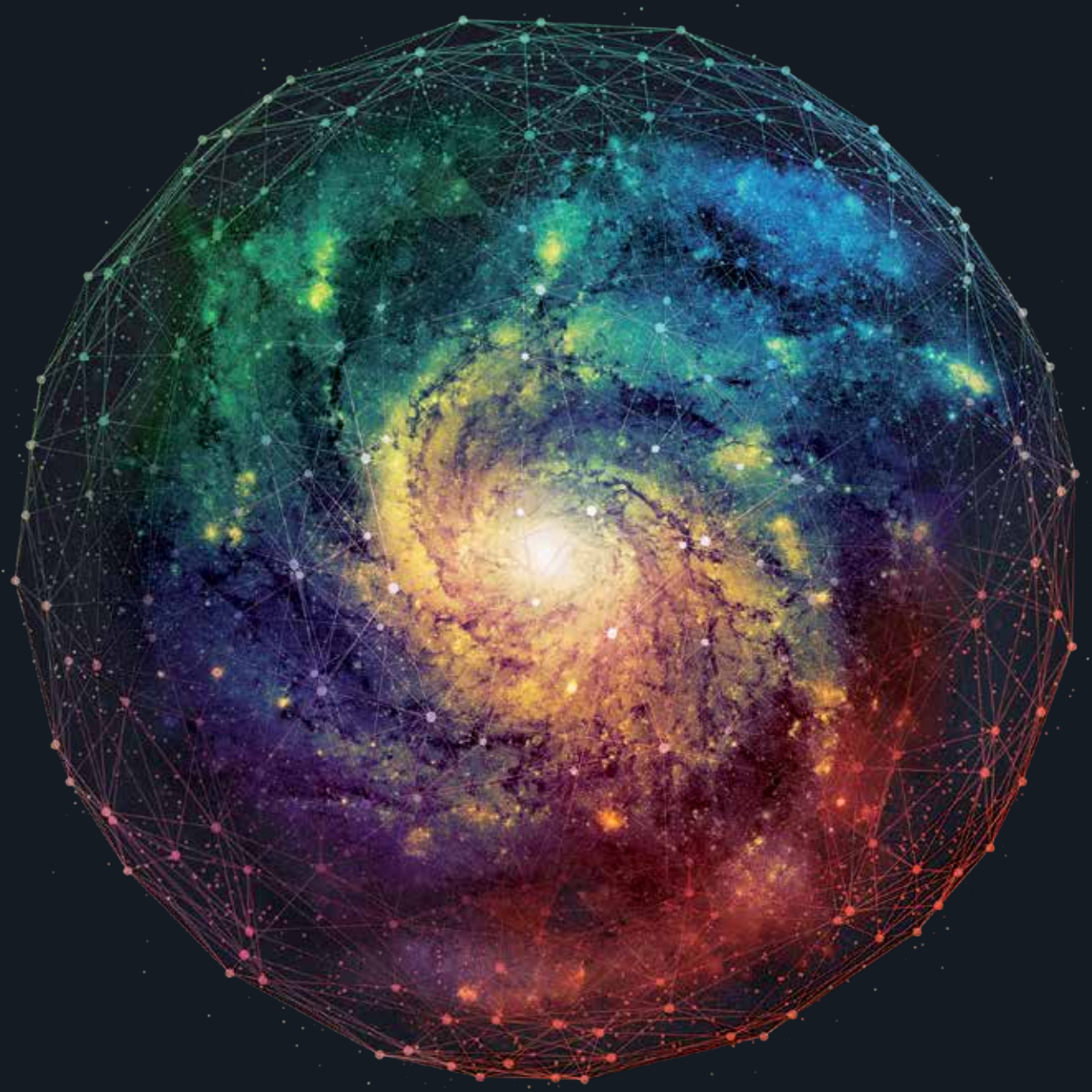
2020 RESEARCH AREAS

ENGINEERING



WORLD READY

2020

THERE IS WHERE YOU ARE RIGHT NOW, AND THERE IS WHERE YOU WANT TO GET TO. IN BETWEEN YOU NEED A BRIDGE. ECU IS THAT BRIDGE BETWEEN YOUR WORLD, AND THE WHOLE WORLD.

BECOME WORLD READY AT ECU.

CONTENTS

ECU is committed to reconciliation and recognises and respects the significance of Aboriginal and Torres Strait Islander peoples' communities, cultures and histories. ECU acknowledges and respects the Aboriginal and Torres Strait Islander peoples, as the traditional custodians of the land. ECU acknowledges and respects its continuing association with Nyoongar people, the traditional custodians of the land upon which its campuses stand.

MESSAGE FROM THE ASSOCIATE DEAN OF RESEARCH

The School of Engineering at Edith Cowan University (ECU) is one of the fastest growing engineering schools in Australia. The School enjoys some of the best equipped hardware laboratories in the nation, with regular multi-million dollar investments into expanding and maintaining its world-class infrastructure. It has been ranked in the top 151-175 for Engineering and Technology by the Times Higher Education World University Rankings for 2020.

Research at the School encompasses a broad range of engineering disciplines and allied sciences including chemical, civil, mechanical, electrical, and petroleum engineering. This breadth of disciplines positions us well to undertake research in sustainability engineering, which is multidisciplinary in nature.

Our research focuses on Natural and Built Environments theme and include research priority areas:

- Engineering, technology and nanotechnology
- Sustainability of energy, water, materials and resources

The School has an outward looking research and development perspective. We endeavour to proactively identify and develop innovative solutions to real-world engineering problems, particularly those relevant to Australian industry and the community.

ASSOCIATE PROFESSOR MEHDI KHIADANI
ASSOCIATE DEAN RESEARCH
SCHOOL OF ENGINEERING

ECU RESEARCH THEMES & PRIORITY AREAS

Research at ECU is focused on 4 main research themes:

- Health: Prevention, detection and management of disease and injury
- Society and Culture: Impacting and supporting social change through ensuring diversity, creativity, cultural identity, education, personal and organisational success and social justice
- Natural and Built Environments: Understanding, harnessing, building and protecting environments for sustaining people, place and planet
- Securing Digital Futures: Enabling a safe, secure, productive and enterprising digital environment

ECU's research is characterised by its fundamental commitment to the pathway from basic research to translation to innovative implementation (including practice, service delivery, and industry adoption).

ECU's commitment to this research pathway is reflected in its cross-cutting approach to research across each of its research themes and priority areas. These cross-cutting approaches are:

- A strong research–practice interface, including research-led practice and practice-led research, that involves and engages the professions, service-delivery agencies and other end-users (patients, clients, consumers, industry).
- Strengthening the evidence base by responding to the needs of high-end practitioners, policy-makers, guideline developers, activists, companies and governments, thereby ensuring they have access to expert advice and robust data for decision-making.
- Assessment, evaluation, advocacy, policy-making throughout all stages of planning, measurement and monitoring as well as the early stages of innovation.
- Indigeneity and diversity to reach a fuller understanding of aboriginal knowledge, practice, and belief and the diversity of the cultures among which we live and research.

RESEARCH AREAS

CHEMICAL ENGINEERING RESEARCH

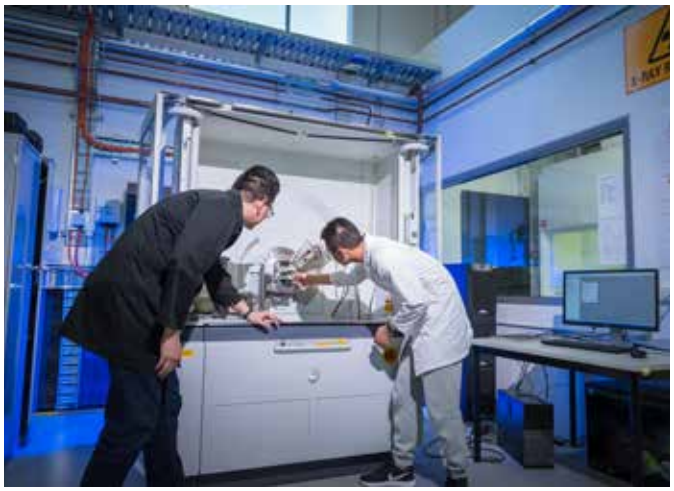
Areas covered include solar energy conversion; environmental nanotechnology; mining and mineral processing; and hydrocarbon synthesis from methane and carbon dioxide.

GEOTECHNICAL AND GEOENVIRONMENTAL ENGINEERING RESEARCH

Areas covered include geosynthetic applications; fibre-reinforced soils; slope stability; engineered landfills; buried structures; static and dynamic earth pressures; utilisation of mine and other wastes in construction; pavement structure; and ground improvement techniques.

MECHANICAL DESIGN & MANUFACTURING ENGINEERING RESEARCH

Areas covered include composite manufacturing techniques; hydraulic valve development; non-intrusive experimental flow visualisation; design optimisation; and automotive design and development.



MATERIALS ENGINEERING RESEARCH

Areas covered include advanced materials design; materials synthesis; microstructure characterisation; and material properties evaluation for various engineering applications.

WIRELESS COMMUNICATIONS & ENVIRONMENTAL MONITORING RESEARCH

Areas covered include wireless communications; environmental monitoring; wireless sensor networks; green communications; next generation wireless broadband networks (i.e. 5G); sensors and devices; frequency selective surfaces; digital image processing; and structural health monitoring.

WATER RESOURCES AND ENVIRONMENTAL ENGINEERING RESEARCH

Areas covered include environmental fluid mechanics; hydraulics; urban water; pollutant transport; desalination; water and wastewater treatment; renewable energy in water and wastewater treatment applications.

THERMOFLUIDS RESEARCH

Areas covered include integration of renewable energy sources; demand forecasting; electric vehicles; energy storage systems; decision making and generation.

POWER ENGINEERING & RENEWABLE ENERGY RESEARCH

Areas covered include integration of renewable energy sources; demand forecasting; electric vehicles; energy storage systems; decision making and generation.

PETROLEUM ENGINEERING RESEARCH

Areas covered include enhanced oil recovery (EOR); reservoir modelling; unconventional resources (coal, gas hydrates, shale); hydraulic fracturing/fracture stimulation; formation damage control; and CO2 geo-sequestration.

RESEARCH SUPERVISION

Staff in the School of Engineering are engaged in cutting-edge research in several important fields, as represented by our diverse research areas. While our research activities are contributing to the advance of scientific knowledge in these fields, we are particularly keen to undertake projects that are directly beneficial to industries in Western Australia. We encourage prospective postgraduate research students to make contact with potential supervisors to discuss topics before applying.

A comprehensive list of our staff can be found at:
www.ecu.edu.au/schools/engineering/staff

Please note that admission into a research degree is dependent on the availability and capacity of a supervisor to take on new research students.

For more information on research degrees, visit:
www.ecu.edu.au/degrees/research

FACILITIES

The School of Engineering has an extensive range of well-equipped labs to support our teaching and research:

- circuits and systems
- power systems
- robotics and automation
- communications systems
- Siemens instrumentation and control
- engineering materials
- thermodynamics
- fluid mechanics
- flight simulator
- digital imaging
- communication research
- measurement and characterisation
- modelling
- nanomechanical testing
- optical systems
- microelectronics device characterisation
- manufacturing workshop
- motorsports workshop
- automotive characterisation and performance
- concrete and construction materials
- geotechnical and pavement engineering
- structural engineering
- surveying
- hydraulics engineering
- process engineering
- Schneider Electric instrumentation control and automation
- renewable energy
- advanced instrumentation
- environmental engineering
- energy and environment
- petroleum engineering
- advanced manufacturing

RESEARCH HIGHLIGHTS

3D PRINTING OF TITANIUM ALLOYS FOR BIOMEDICAL APPLICATIONS

Project Leader: Professor Laichang Zhang

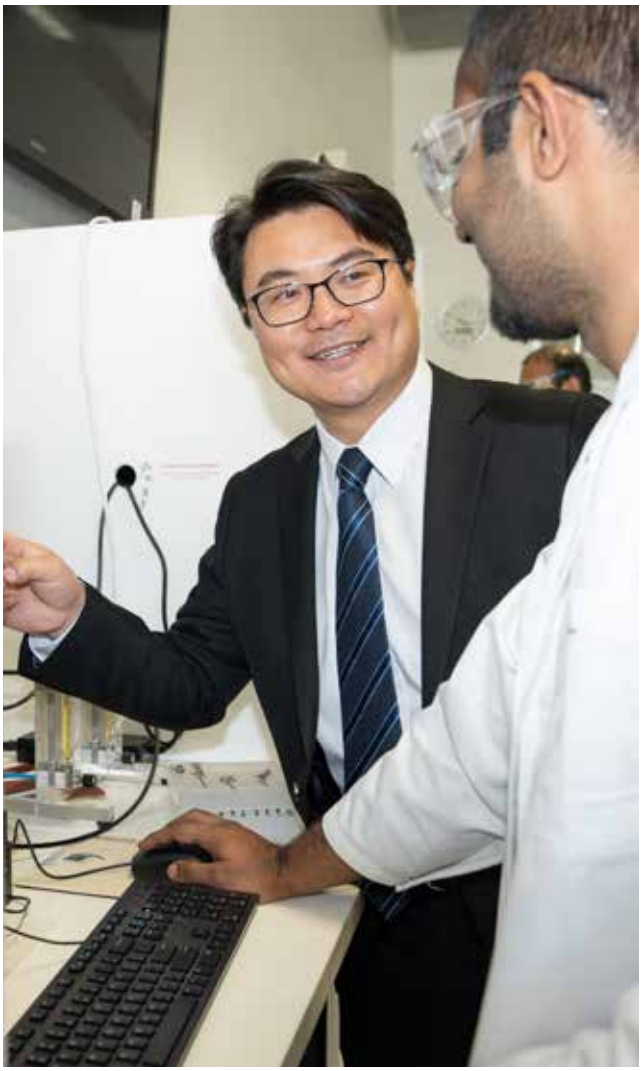
Titanium materials are ideal targets for 3D printing, because they are expensive and difficult to machinery using conventional processing technologies. Prof Zhang has significantly contributed to 3D printing of titanium alloys, especially the processing optimisation, microstructure and their properties (e.g. mechanical behaviour, fatigue properties, corrosion behaviour). Some highlights of the achievements are shown below:

- the manufacturing, microstructure and mechanical properties (both in static and fatigue properties) of 3D-printed beta-type titanium with different porous structures were systematically investigated.
- a method was proposed to search for optimal processing parameters for high-density components by 3D printing.
- a method was proposed to produce composites by 3D-printing to solve the problem for unavailabiltiy of composite powder for 3D printing. The produced composites exhibit superior mechanical properties.
- the corrosion behaviours of 3D-printed titanium alloys (as well as other metallic alloys) prepared were systematically investigated.

NANOCATALYSIS FOR ENERGY AND ENVIRONMENTAL APPLICATIONS

Project Leader: Professor Hongqi Sun

Catalytic oxidation has demonstrated extensive applications for environmental applications, particularly in degradation of organic pollutants. Conventional metal-based materials as the catalysts are efficient, but have the potential risks of resulting in secondary contaminations. The group applies metal-free materials as novel catalysts for sulfate-radical based advanced oxidation processes (SR-AOPs). The mechanism has also been discussed. Recently, as the alternative to metal-based semiconductors, an emerging carbon-based photocatalyst, namely graphitic carbon nitride (g-C3N4), has been intensively used for photocatalytic reactions. The group has also worked on modification of pristine carbon nitride for environmental and energy applications. Mechanistic studies on the morphology, copolymerization, doping, hybridization and sensitization have been conducted.



DESIGN AND IMPLEMENTATION OF AN AUTONOMOUS SYSTEM FOR CATCHMENT PROTECTION

Project Leader: Professor Daryoush Habibi

Protection of water catchment facilities is essential for safe and cost-effective supply of drinking water. The monitoring of vehicles and personnel who gain legitimate access and that of illegal intrusion is therefore crucial for the protection of the facilities.

Source Protection is recognised as fundamental for safe and cost-effective supply of drinking water. One of the biggest challenges of source protection is the control of human access to prevent contamination. With human access come risks such as introduction of pathogens, pollution and environmental degradation.

To manage this risk, Rangers conduct regular surveillance and by-law enforcement. The integration of traditional ranger patrols with covert surveillance technologies has greatly improved the Corporation's ability to manage threats to drinking water quality posed by illegal access and incompatible activities.

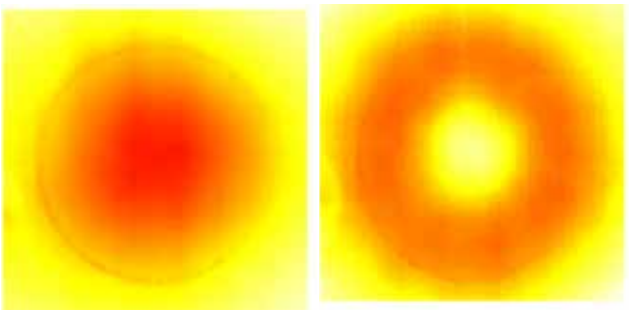
In this project, which is fully funded by the Water Corporations WA for a period of three years, the team of researchers from ECU have developed a ground based surveillance network to prevent unauthorized access to protected zones around the water catchment areas.

THE EFFECTIVENESS OF TURBULENT JET HEAT TRANSFER

Project Leader: Associate Professor Yasir Al-Abdeli

Timber manufacture, heat treatment of parts during fabrication and the thermal management of engineering systems relies in many occasions on cool (or heated) impinging flows. The role by which various operating parameters affect turbulent jet heat transfer, under both swirling and non-swirl conditions, has been investigated over several years by the Thermofluids Research Group. In particular, these activities have spanned:

- Modelling of the upstream and impingement zones using Computational Fluid Dynamics to resolve the flow field.
- Experiments to define the role of swirl (rotational flow imparted into an axisymmetric jet) can influence the magnitude and uniformity of steady state heat transfer on a (heated) impingement surface.
- Infrared imaging to resolve the transient stages of heat transfer associated with jet impingement.



CO2 GEO-SEQUESTRATION IN AN OIL RESERVOIR

Project Leader: Professor Stefan Iglauer

CO2 geo-sequestration in oil reservoirs is an economically attractive solution as it can be combined with enhanced oil recovery (CO2-EOR). However, the effectiveness of the associated three-phase displacement processes has not been tested at the micrometer pore-scale, which determines the overall reservoir-scale fluid dynamics and thus CO2-EOR project success. We thus imaged such displacement processes in-situ in 3D with x-ray micro-computed tomography at high resolution at reservoir conditions, and found that oil extraction was enhanced substantially, while a significant residual CO2 saturation (13.5 %) could be achieved in oil-wet rock. Statistics of the residual CO2 and oil clusters are also provided, they are similar to what is found in analogue two-phase systems although some details are different, and displacement processes are significantly more complex.

RENEWABLE ENERGY APPLICATION FOR FRESHWATER PRODUCTION

Project Leader: Associate Professor Mehdi Khiadani

Water shortage has affected millions of people in the world and predictions evaluate the situation in the future as warning. Many researchers have tried to combat this global issue, however, all the studies and activities have faced an important obstacle which is energy. The dependence of energy and water is now becoming more and more evident because of their regional, environmental and economic implications. Hence, attention has been drawn towards solar energy as a free and clean source, and thermal-driven membranes a growing and promising new-comer. During the last decade, there have been several studies and attempts to integrate solar energy and membrane technology, however, it is not yet a straightforward matter.

The Water and Environmental Research team in the School of Engineering at ECU is performing extensive mathematical modelling and laboratory measurements:

- To design and develop a new and efficient solar membrane-based solar system for desalination and wastewater treatment.
- To test and validate the performance of the proposed integrated system in producing fresh water from saline water and improving the quality of residential grey water.
- To investigate the key parameters to improve the fresh water production rate in desalination, water and wastewater treatment applications.
- To improve the thermal and overall efficiency of solar membrane-based system.

APPLYING TO ECU

Getting ready to apply for a research degree can seem quite daunting so we've laid out the following process to assist you. We recommend that you complete your application four to six weeks prior to any deadline. An incomplete application will result in delays, which means you could potentially miss deadlines, so make sure that your application is complete before submitting it.

CHECK YOUR DATES

Masters by Research courses and the Integrated PhD have a specific start date and application deadlines. However, applications for the standard PhD are open all year round. Keep in mind that ECU's Research Scholarships also have opening and closing dates. If you are interested in applying for a scholarship, visit the Scholarships website: **ecu.edu.au/scholarships**

KNOW YOUR TOPIC

You will need to prepare a 300-word abstract and a two-page proposal on your topic. Your initial abstract and proposal will tell us about you, including how much you know about ECU, research in your area of study, how passionate you are about your subject, and how familiar you are with the prospective supervisors within the schools.

PREPARE YOUR DOCUMENTS

In addition to your abstract and proposal, you will need to submit the following:

- Academic certificate transcripts (secondary and/ortertiary studies) in both the original language and official certified English translation (if applicable)
- English proficiency test scores
- Copy of passport photo page (if applicable)
- Résumé/Curriculum vitae (if applicable)
- Work reference (if applicable)
- Marriage or name change certificate (if applicable)
- Copies of your Honours or Masters Thesis, as well as any publications you have produced

APPLY DIRECTLY TO ECU OR THROUGH AN AGENT

Visit the Application Portal: **apply.ecu.edu.au** to apply for your course, including uploading your documents. You can also track the progress of your application here.

Please note that ECU requires certain nationalities to apply via an authorised agent. Visit **ecu.edu.au/future-students/applying/find-an-authorised-agent** to find an agent near you.

RECEIVE OUR INITIAL ASSESSMENT

The initial assessment will take into account your qualifications, topic, abstract and proposal to ensure it is closly aligned with our areas of research focus, and that we have supervisors in your research area. This can take four to six weeks, depending on academic availability. Please note that during December and January this process may take longer.

We will communicate with you via email, so it is important for you to check your email regularly to ensure there are no delays with your application.

PROGRESS YOUR APPLICATION

If your application satisfies all our criteria, it will be progressed for further assessment. At this stage your qualifications will be verified and a research supervisor will be assigned to you. Processing time for the assessment of your application will vary based on academic availability.

OUTCOME OF YOUR APPLICATION

You will be advised of the outcome of your application via email. If you are successful, you will receive an offer to commence your studies at ECU.

ACCEPT YOUR OFFER

Your offer letter will contain specific instructions as to how to accept your offer via our online system.

If you have questions about your application, contact Admissions: HDR.enquiries@ecu.edu.au

ENGINEERING

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