

# ENGINEERING

## Research Interests and Strengths

Engineering is comprised of the Schools of Chemical; Civil, Environmental and Mining; Electrical and Electronic; and Mechanical Engineering; and the Australian School of Petroleum. The Schools of Computer Science and Mathematical Sciences also contribute to programs offered by Engineering.

Engineering has a fine reputation for innovative research across a wide range of fields. Individual staff members have close links with industry, their research is well supported and a significant number are world leaders in their disciplines. Many of their technological breakthroughs form the basis of independent companies.

The Faculty has an extensive research infrastructure. Specialist facilities include acoustic and microwave anechoic chambers, micro-circuit design suites, bioprocessing, combustion and water laboratories, earthquake simulators, strongfloors, dynamic testing machines and a visualisation laboratory. All Schools have access to state-of-the-art software for design and analysis purposes.

## CHEMICAL ENGINEERING

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The School has a strong research team that is focused on solving problems and providing answers for industry and the wider community. Research groups study a wide spectrum of problems and have a strong connection to related industries, which provide much of the necessary funding.

### Research Interests

#### Biochemical Engineering

- Design, modelling and simulation of processing systems for the production of recombinant proteins from genetically engineered microorganisms and for the production of non-specific growth factors for by-product cheese whey
- Design of processing system disinfection for the elimination of contaminating microorganisms.

#### Chemical Kinetics and Reaction Engineering

- Catalysis
- Combustion and gasification of coal
- Laser studies of the reactions of silicon and germanium associated with microelectronic component
- Reaction engineering studies of coal processing have important ramifications in the study of greenhouse gas production in association with combined cycles power generation systems, catalytic decomposition of nitric oxide and engine exhaust clean-up Thermal pyrolysis.

#### Fluid and Particle Mechanics

- Development of a continuous flow rheometer for industrial slurries
- Dynamic settling of particles in a sheared fluid
- Effect of mechanical vibrations on settling behaviour of flocculated suspensions
- Flow visualisation of time-dependent viscoplastic fluids in Couette and coating flows



- Mechanics of phase inversion in liquid-liquid emulsions
- Numerical modelling.

#### Laser Diagnostics and Combustion Engineering

- Gas combustion
- Laser diagnostic techniques have greatly contributed to our understanding of complex phenomena. The non-intrusive nature of the laser radiation allows precise probing, with high temporal and spatial resolution, without interfering with the flow
- Plasma
- Turbulent flow.

#### Process Systems Engineering

- Automated process operating command systems
- Behaviours of chemical processes and their associated equipment
- Biochemical engineering processes
- Development of mathematical models
- Dynamic simulation of water treatment
- Optimisation and retrofitting of process energy systems

- Technical and economic optimisation of such plant in the context of a standard industrial environment

#### CIVIL, ENVIRONMENTAL AND MINING ENGINEERING

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#### Research Interests

- Artificial intelligence techniques applied to water resources management
- Coastal zone processes and near shore sediment transport
- Column separation in water hammer
- Composite steel and concrete structures
- Computer numerical modelling of hydraulic systems
- Diagnosis and assessment of civil infrastructure
- Domestic waterhammer
- Earthquake engineering and structural dynamics
- Earth retaining structures
- Enhancing learning and teaching in civil engineering

- Environmental geotechnics and landfills
- Expansive soil behaviour and design
- Fatigue assessment of residual strength and endurance
- Finite element modelling in structures and hydraulics
- Geostatistics
- Hydraulic modelling of pipe networks and transients
- Hydrology, especially rainfall modelling
- Infrastructure diagnosis, assessment and rehabilitation
- In situ and laboratory testing of soil and rock
- Joint probability analysis in water engineering
- Leak detection in pipe networks
- Masonry structures
- Modelling unsteady flow in irrigation systems
- Non-linear analysis and design of concrete structures
- Optimisation of water systems using genetic algorithms
- Physical hydraulic modelling
- Probabilistic methods in geomechanics
- Response of soils to cyclic loading

### Professor Graham (Gus) Nathan Staff Member



Gus Nathan is passionate about sustainable energy.

Deputy Director of the Research Institute for Climate Change and Sustainability Institute and head of the Fluid Mechanics, Energy and Combustion Research Group—the largest research group within the Faculty of Engineering, Computer and Mathematical Sciences, Gus Nathan is passionate about the development and implementation of sustainable energy.

He is actively involved in establishing partnerships with industry and government to adopt multi-disciplinary approaches to mitigate greenhouse gas emissions and he has worked with a range of industries and research organisations in sectors spanning power generation, minerals processing, transport fuels and Olympic flames in order to develop and implement cleaner technologies. His work has included technologies to mitigate emissions of NO<sub>x</sub>, CO<sub>2</sub>, fine particles and soot and has

led to the joint development of award winning technologies such as "Gyrotherm" low-NO<sub>x</sub> burner technology applied in the cement, lime and steel industries and low emission flames used in the Olympic Torches at the Sydney and Athens Olympic Games, and in the Stadium Flames at Athens and Doha.

#### IN ADDITION, GUS IS ENGAGED IN EMERGING TECHNOLOGIES SUCH AS GEOTHERMAL, SOLAR-THERMAL, BIOMASS WIND AND WAVE TECHNOLOGY.

He has published over 150 peer-reviewed articles in the field and is the joint inventor of seven patents. He has undertaken around 50 consulting and contract research programs for industries spanning the cement, lime, aluminium, power generation, mining, steel, glass, petrochemical and geothermal sectors.

- Retrofitting structures with fibre reinforced plastic
- Risk and uncertainty
- River hydraulics
- Spatial variability of soils
- Sustainability in civil engineering
- Water quality monitoring and analysis
- Wetland modelling and design.

## ELECTRICAL AND ELECTRONIC ENGINEERING

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The School has a strong research focus with staff and students active in a wide variety of projects. The School's vision is to increase the scale and impact of world-class research undertaken and to provide the highest quality PhD supervision. Research activities span fundamental theoretical advances through to commercial spin-offs. Recent research outcomes include significant contributions to power systems, radar signal processing, terahertz imaging, biologically inspired vision and radio frequency identification (RFID).

## Research Interests

### Sensor, Signals and Information Processing

Major thrusts include signal processing and sensor systems for:

- Biomedical applications
- Imaging
- Navigation
- Surveillance.

Research Centres:

- Centre for Biomedical Engineering (CBME)
- Centre for Expertise in Phased Array and Microwave Radar Systems (CEPAMiR)
- Sensor Signal Processing Program (SSP).

### Power Engineering

Major thrusts include:

- Power electronics, electrical machines and drives
- Power quality and condition monitoring
- Power system dynamics and control
- Renewable energy systems and electric transportation.

### Microelectronics and Radio Frequency Engineering

Major thrusts include:

- Antennas and radio wave propagation
- Integrated microelectronic RF systems
- Lightweight cryptography for passive RFID systems
- RFID technologies for supply chain management application
- VLSI for high speed high performance applications.

Research Centres:

- Adelaide Auto-ID Lab
- Centre for High Performance Integrated Technologies and Systems (CHIPTec).

### Telecommunications

Major thrusts include:

- Automated planning and concurrent systems science
- Commercial, policy and regulatory issues in telecommunications, internet and the media
- Forensic investigation techniques for telecommunications and multimedia
- Performance analysis and quality of service provisioning for wireless and wired networks

## Professor Angus Simpson Staff Member



“We’re making sure there’s water in every tap each time it’s turned on.”

When pipes burst, precious water is wasted. Based on research by Professor Angus Simpson at the University of Adelaide, there are better ways to have an impact on dramatic pipe failures. Water is life. But delivery infrastructure is rapidly ageing and is prone to failure - sometimes dramatic. It is a global problem with many countries losing up to 35% through water leakage. “When water pipes burst, the wastage is very visible. However blockages, minor leaks and valve malfunctions occur every day. And water is wasted without detection.”

The University of Adelaide has created a water research cluster that brings together researchers in engineering, science, economics, irrigation science and architecture. This Cluster has created a much greater focus on integrated water research within the University

to solve practical problems for the community, government and industry. Professor Angus Simpson and his team in the School of Civil, Environmental and Mining Engineering at the University of Adelaide have found a way to find leaks and identify pipe weakness before trouble occurs.

“We can very quickly find leaks and bursts using computerised water hammer techniques. In addition, we’ve replaced invasive and expensive cameras with inverse transient techniques, based on 10 years’ research. We listen to what the pipes tell us and that gives us an extremely detailed image of the pipe’s condition. Droughts bring water conservation to the forefront. However the delivery of fresh water is a global problem. We’re making sure there’s water in every tap each time it’s turned on.”

- Signal processing, coding and system design for communications and radar systems.

Research Centre:  
Centre for Internet Research.

## MECHANICAL ENGINEERING

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The School of Mechanical Engineering is proud of its long-standing tradition of high quality research and postgraduate student education. Many of our higher degree graduates gain employment with high-tech companies and consultancies, working nationally and internationally.

Occupations of higher degree graduates can range from research engineer to industrial product designer and innovator, management consultant, specialist technical engineering consultant, university professor, or even astronaut.

Graduates are in great demand and occupy a wide range of positions in industry and government. A postgraduate degree from the School of Mechanical Engineering is a passport to an exciting, innovative, rewarding and productive career.

### Major Research Activities:

- Acoustics
- Active and passive flow control
- Active noise control
- Active vibration control
- Advanced composite materials
- Aeracoustics
- Aeronautics
- Aerospace
- Airconditioning
- Aircraft design
- Alternative fuels
- Biological flows
- Biomechanics
- Combustion
- Computational methods in fluid and solid mechanics
- Control
- Engineering education
- Fatigue and fracture of welded structures
- Flames and industrial burners
- Flow induced instability
- Flow measurement and visualisation
- Fluid mechanics
- Fracture mechanics
- Gaseous explosion modelling
- Heat transfer
- Industrial noise control
- Jets and wakes
- Materials science
- Materials, welding and fracture mechanics
- Mechatronics
- Micro motion stages and systems
- MILD combustion
- Mixing of fuel jets
- Non-linear dynamics
- Particle-laden flows
- Plasma aerodynamics
- Precessing jet flows and flames
- Robotics
- Solid mechanics
- Space engineering
- Stress analysis
- Structural health monitoring
- Structural integrity and life extension
- Supersonic combustion
- Sustainable energy
- Turbulent reacting flows
- Ultrasonics
- Underwater acoustics
- Unmanned Air Vehicles
- Unsteady pipe flows
- Vibration
- Welding metallurgy
- Wind engineering.

