UNSW AUSTRALIA

High-Performance Composites Research

Never Stand Still | Engineering | Mechanical and Manufacturing Engineering

Fibre Placement
Environment
Industrial
Strength
Infusion
Curing
Energy
Crashworthiness
Transport
Impact
Mechanics
Design
Composites
Built
Thermoplastics
Fatigue
Aerospace
Analysis
Nanocomposites
Infrastructure
Testing

Our facilities

The Automated Composites Laboratory within Mechanical and Manufacturing Engineering at UNSW Australia allows students, academics and industry partners to solve real-world engineering challenges.

Australia is already considered a global leader in the field of composites research. With its leading academics and some of the most advanced equipment available in any educational organisation, UNSW is helping to develop essential fabrication capabilities across Australia and the Asia-Pacific region.

The Automated Composities Laboratory plays an important role in national composites science and engineering. It is a major learning centre for PhD students and helps a range of industries develop groundbreaking composite technologies.

This world-class facility is a true "one-stop shop". Onsite instruments include an Automated Dynamics robot platform that provides fast, precise and flexible automated composite fabrication. The laboratory also has leading-edge fatigue testing, curing and drop-impact instruments, and a hydraulic isolated test bed, that enable accurate and repeatable results for a range of projects.

The laboratory is within Mechanical and Manufacturing Engineering's $70 million Ainsworth Building complex – an integrated, state-of-the-art facility considered to be one of the world's best.

Our strengths

- Australia's only Automated Fibre Placement (AFP) facility
- Aerospace-grade processing capability
- Structural testing of large components with complex loading capability
- Material characterisation, design, analysis, lay-up, curing and testing under one roof
- Ready to partner with industry for applied research opportunities

PHOTO: KIEV.VICTOR/SHUTTERSTOCK

Our projects

On a collision course

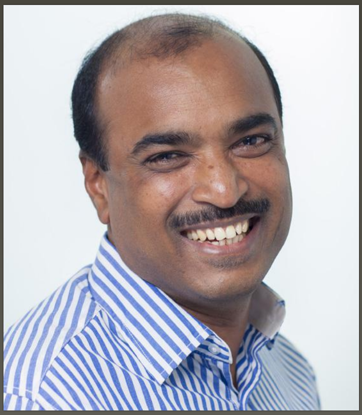
UNSW has developed retrofittable technologies and integrated design methodologies for the Australian Defence Force to improve the crashworthiness of its aircraft and rotorcraft. Our team has developed energy absorber solutions for ageing airframes and variable-load energy absorbers for vehicle designs that adjust to the severity of a crash.

A mind of their own

UNSW has developed novel applications for embedded sensor technologies to monitor the processing and structural health of composite components. We have used fibre Bragg gratings (FBGs) for real-time measurement of conditions during Automated Fibre Placement of laminates, providing life-long health monitoring of composite parts, even during fabrication.

Driven round the twist

In collaboration with the Maritime Platforms Division of DST Group, UNSW is developing super-efficient composite propellers for large ocean-faring vessels. The novel propellers use an exotic property of composites, bend-twist coupling, to achieve unparalleled efficiency across a range of operating conditions. Our team has developed optimisation and analysis tools to help design and manufacture these remarkable components.



Professor Gangadhara Prusty

Gangadhara Prusty (pictured) leads the Advanced Structures and Materials group at Mechanical and Manufacturing Engineering. He is also Deputy Director of the Centre for Sustainable Materials Research Technology (SMaRT). He led the establishment of UNSW's new composites facility including robotic manufacturing and his research strengths are in the mechanics of composites at nano-, micro- and macroscales, using the latest analysis and modelling techniques blended with material characterisation. He has contributed to many fundamental developments in the field of Mechanics of Composite Materials and Structures, such as the novel stiffened plate/shell formulation using finite elements for large stiffened structures, the hierarchical multiscale sub-modelling approach for the Onset Theory, efficient modelling of Barely Visible Impact Damage (BVID) in post-buckled structures, robust design optimisation for lay-ups in shape-adaptive composite propellers and structural health monitoring of composite structures using photonic technologies. His work is closely aligned with the emerging research strength at UNSW of next-generation materials and technologies.

PHOTOS: GRANT TURNER

UNSW's Automated Composites Laboratory.

From atoms to aeroplanes

Development and certification costs for new composite aircraft are a huge burden for all aircraft manufacturers, mainly because of the complex and expensive testing requirements for new materials and designs. Dr Garth Pearce (pictured) is leading a joint project involving UNSW and Boeing to revolutionise the composite design process. This has been built on the back of 10 years of successful collaborations between the organisations. The atoms-to-aeroplanes approach combines powerful simulation tools and simple experiments to predict the properties of composite components from the most fundamental behaviour of the constituent atoms and molecules.

Keep your keel on

David Lyons (pictured) envisions a day when lives are no longer lost at sea due to composite yacht failures. Using UNSW's state-of-the-art composite processing, testing and analysis facilities, David is uncovering the root causes of catastrophic keel failures that have led to more than a dozen fatalities over the past two decades. He brings 27 years of experience as a composites naval architect, yacht designer and consulting engineer to the project.

David aims to generate new design rules and guidelines for fibre-reinforced composite yachts that are easy to use yet protect future sailors from harm.

Our equipment

Composite Manufacturing Robot

This state-of-the-art Automated Fibre Placement (AFP) robot is the centrepiece of the Automated Composites Laboratory, and allows for the integration of computer-aided design, analysis and manufacture of composite components. The AFP facility features a coordinated multi-axis robot and spindle system for maximum control over fibre trajectories and part geometry. The facility includes a head for laying parallel thermoset prepreg composite tows as well as a specialist thermoplastic composite head for in-situ melding (melting and welding) for one-shot part fabrication.

Specifications:

+ 6 axis robot platform with coordinated spindle
+ 4 tow thermoset prepreg processing head
+ High-temperature thermoplastic placement head
+ Part processing up to ~4m
+ Integrated software for CATIA and Solidworks
+ A range of flat and revolute tooling

Automated Dynamics Composite Manufacturing Robot

PHOTOS: GRANT TURNER

Instron 8804 Axial Servohydraulic Testing Machine

Instron 8804 Axial Servohydraulic Testing Machine

Features a high-stiffness 4 column frame for testing up to 500kN. Can be used for static and fatigue testing of metals and composites for a large range of applications.

Instron CEAST 9350 Drop Tower Impactor

High-energy and high-velocity impact testing machine up to 1800J and/or 24m/s. Caters for a range of impact specimen types in a thermally controlled environment (-70 to 150°C).

Other instruments

Hydraulic Multiaxial Test Bed: 16-square-metre envelope, 4-100kN Instron dynacells, designed to test large components under multi-axial loading.

Laying table: Allows ambient cure vacuum resin infusion of flat monolithic and sandwich panels up to 1.8m x 1.2m.

ASC Econoclave: Industrial-grade autoclave for specimens up to 1.1m diameter x 1.5m long. Maximum working pressure of 7 bar and maximum working temperature of 250°C.

ASC Econoclave

Our research

Structural Mechanics, Strength and Life Prediction

+ Physics-based failure prediction
+ Fracture mechanics and damage propagation
+ Fatigue of short-fibre composites
+ Robust design of imperfection-sensitive structures
+ Shape adaptive structures
+ Bolted and bonded joints
+ Composite repairs

Crashworthiness

+ Impact modelling and testing
+ Novel energy absorbers
+ Energy absorption of hybrid materials

Nanocomposites

+ Nano-modified composites
+ Molecular dynamics of polymers and nanoadditives

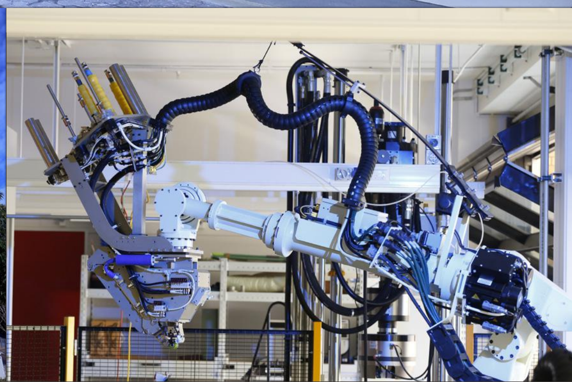
Automated Fabrication and Additive Manufacturing

+ Automated Fibre Placement (AFP)
+ Bespoke fabrication
+ In-situ thermoplastic melding
+ Process modelling and monitoring

Structural Health Monitoring

+ Fibre Bragg gratings and optic sensors for composite materials and structures
+ Applications of smart composite structures
+ Shape-adaptive composite structures

GROUP OF EIGHT AUSTRALIA
MEMBER



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