



Net Zero Initiative Transforming Wind Farm Operations



Our vision and mission

Our vision is to enable lower cost renewable energy through a deep and rigorous integration of measured data, simulation, control and operational decision making. Our mission is to bring together globally leading researchers, large scale renewable industry and government partners to transform operational decision making for renewable energy assets.

The first goal is the delivery of a revolutionary approach to the optimisation and control of wind-farm operations. Once achieved, this will reduce the cost of wind energy and extend the capabilities of existing and planned wind farms.

Our approach

We have brought together a team of world-class aerospace, structural, electrical, control and robotics researchers to develop wind farm digital twins, which employ high accuracy, physics-informed, data-driven modelling and optimisation of wind turbines and whole wind farms. Our industry partnership ensures our solutions will be rapidly translated and will have direct impact on wind farm operations in Australia and globally.

Our research

A key Enabling Research Theme of the Net Zero Initiative (NZI) is 'Emissions Avoidance through Zero Emissions Energy'. Under the pillar 'Transforming Wind Farm Operations', our researchers are developing a framework to fuse engineering models and data, advancing understanding of complete wind farm operations.

We aim to tackle nearly \$200m/yr of inefficiencies in Australia alone, caused by aerodynamic interference between turbines and downtime due to unscheduled maintenance. These costs could be reduced with optimal control of individual turbines accounting for wake losses, structural loads, and impacts on power systems.

To deliver this vision we must address three key research challenges:

- Innovations in high fidelity computational physics to model complete wind farms.
- New methods in machine learning combining physics-based analysis with live data from wind farm instrumentation to obtain accurate estimates of wind farm state.
- Advanced approaches to generation of fast models for short term performance prediction.

Meet our research experts

Our research leaders span aerospace, civil, non-linear control, electrical engineering and computer science. Experts working under this pillar include:

Faculty of Engineering

Professor Ben Thornber: Specialises in computational fluid dynamics.

School of Aerospace, Mechanical and Mechatronic Engineering:

Dr Daniel Linton: Specialises in fast, high-fidelity methods for simulating the aerodynamics of wind turbines.

Associate Professor Michael Kirkpatrick: Specialises in fluid dynamics with applications to atmospheric and geophysical convection.

Dr Gareth Vio: Specialises in fluid-structure interaction including aeroelasticity and structural optimisation.

School of Electrical and Information Engineering:

Associate Professor Gregor Verbic: Specialises in modelling, optimisation, decision making and network analysis for sustainable energy systems.

Professor Philip Leong: Specialises in novel hardware accelerated computation

Australian Centre for Field Robotics:

Professor Ian Manchester: Specialises in control, estimation, and identification of nonlinear dynamical systems.

School of Civil Engineering:

Professor Kim Rasmussen: Specialises in structural analysis.

School of Computer Science:

Dr Shuaiwen Song: Specialises in holistic system design and software-hardware co-design.

How your business will benefit

By partnering with us, your business will be able to:

- collaborate with leading academic and industry experts from the University of Sydney to address the challenges faced by your business;
- help shape the next generation of postgraduate students with skills relevant for your business needs;
- host one or more of our talented PhD students, who can be placed in your business for up to one year; and
- benefit (pending eligibility) from the Australian Government's R&D Tax Incentive Scheme.

Current and Past projects

Our capabilities have been demonstrated in several current and prior projects, including:

- The Australian Robotic Inspection and Asset Management Hub, a world leading research hub developing intelligent robotic systems for inspection and asset management.
- simulation and analysis of a complete Australian wind farm in collaboration with our industry partner Iberdrola.
- physics-based wake modelling and machine learning methods for air-to-air refuelling in collaboration with our industry partner Thales.

Contact us

For further information or to discuss in greater detail, please contact:

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