aura
Doctoral Training

EPSRC-NERC Aura Centre for Doctoral Training in Offshore Wind Energy and the Environment

Shaping a resilient future

The Aura Centre for Doctoral Training (CDT) is a transdisciplinary research programme focused on developing a sustainable energy future. The programme is led by the University of Hull in partnership with Durham University, Newcastle University and the University of Sheffield. Working in collaboration, each partner brings unique expertise, enabling a holistic approach to generating innovative solutions to the multi-faceted challenges facing the offshore wind (OW) sector today and in the future. The Aura CDT is an enabler for innovation, unique in its cross-disciplinary engagement of engineering and environmental scientists, industry, and policy makers.

The six Aura CDT research themes address the diverse challenges facing the rapidly expanding offshore wind energy sector. Our research projects work synergistically to address the fundamental challenge of creating a sustainable offshore wind energy sector; technology that supports biodiversity, the circular economy and a cleaner net zero industry.

"What struck me is the multidisciplinary nature of the research projects and how all of those disciplines work together to solve a problem"

David Bould, Lead R&D Specialist, Ørsted

The six Aura CDT research themes

- Physics and Engineering of the offshore environment
- Environment impact, marine biology and aquaculture
- Next generation materials and manufacturing
- Operations, maintenance and human factors
- Offshore wind energy integration
- Big data, sensors and digitalisation

"I'm always excited ... to see the passion, the enthusiasm, and the absolute urgency here that there is for our climate emergency... here we have students engaging in innovation that is going to help in our transition towards a net zero Britain"

Juergen Maier, Chair of the Digital Catapult & Vice-Chair of the Northern Powerhouse Partnership

Led by
UNIVERSITY OF HULL

In partnership with
Durham University
Newcastle University
The University Of Sheffield.

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UKRI Engineering and Physical Sciences Research Council
UKRI Natural Environment Research Council

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Assessing the potential for colocation of aquaculture with offshore wind energy farms using remote sensing

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CATAPULT Offshore Renewable Energy

Postgraduate Researcher: Enora Lecordier

Supervisors: Dr Rodney Forster, Dr Krysia Mazik, Dr Pierre Gernez, Katharine York

Aquaculture and offshore wind energy are two areas of the economy with very high growth potential over the next decade (OECD, 2016). The offshore wind energy sector is expanding rapidly, along the coastal regions and into deeper waters while the UK experiences a net deficit in marine food products. Increasing sustainable aquaculture would add value to the economy as well as providing food security. We are using state-of-the-art satellite datacube technology and ecosystem modelling to evaluate offshore sites with optimal value for colocation of aquaculture and wind energy.

Environment impact, marine biology and aquaculture

Wind sourced energy storage

Postgraduate Researcher: Daniel Whitt

Supervisors: Dr Jean-Sebastian Bouillard, Dr Neil Kemp, Paul Needley

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Enertek International

Generation of energy from wind power is highly intermittent because of the variable nature of wind speed. To provide a more constant and reliable source of energy into the national grid from offshore wind, efficent energy storage in close promixity to the source is essential. One approach is to use the electricity generated by wind energy to generate hydrogen gas from the electrolysis of water. The stored hydrogen gas can then be re-converted back into electricity when required or be used in fuel cells. In this project, we are developing a more efficient means of hydrogen production based on electric-field-driven splitting of water in highly confined nanogap electrodes. Additionally, we are assessing the safety issues around the production, storage and utilisation of hydrogen gas.

Offshore wind energy integration

Modelling and optimisation for a coordinated interconnected multi-terminal DC transmission infrastructure for integration of offshore wind energy

Durham University

Postgraduate Researcher: Siti Khadijah Hamza

Supervisors: Dr Behzad Kazemtabrizi, Dr Mahmoud Shahbazi

As renewables are becoming major contributors to the UK's energy supply, the power grid is experiencing new challenges. Current power systems were not designed for decentralised, intermittent energy resources, as experienced with offshore wind farms. One potential solution is the development of "supergrids": a new type of network topology, based on multi-terminal High Voltage DC links, overlaid on top of AC links, to facilitate interconnection between multiple resources (i.e. wind farms) at a large-scale and in bulk, in a flexible, reliable, and controllable manner. We are developing advanced computational models for power systems, including models that are suitable for solving the optimal power flow problem. We are also developing a suitable day-ahead operational planning framework by solving multiple instances of the optimal power flow problem to plan the operation of offshore wind farms within a specific planning timescale.

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Numerical modelling of wind turbine blade manufacture

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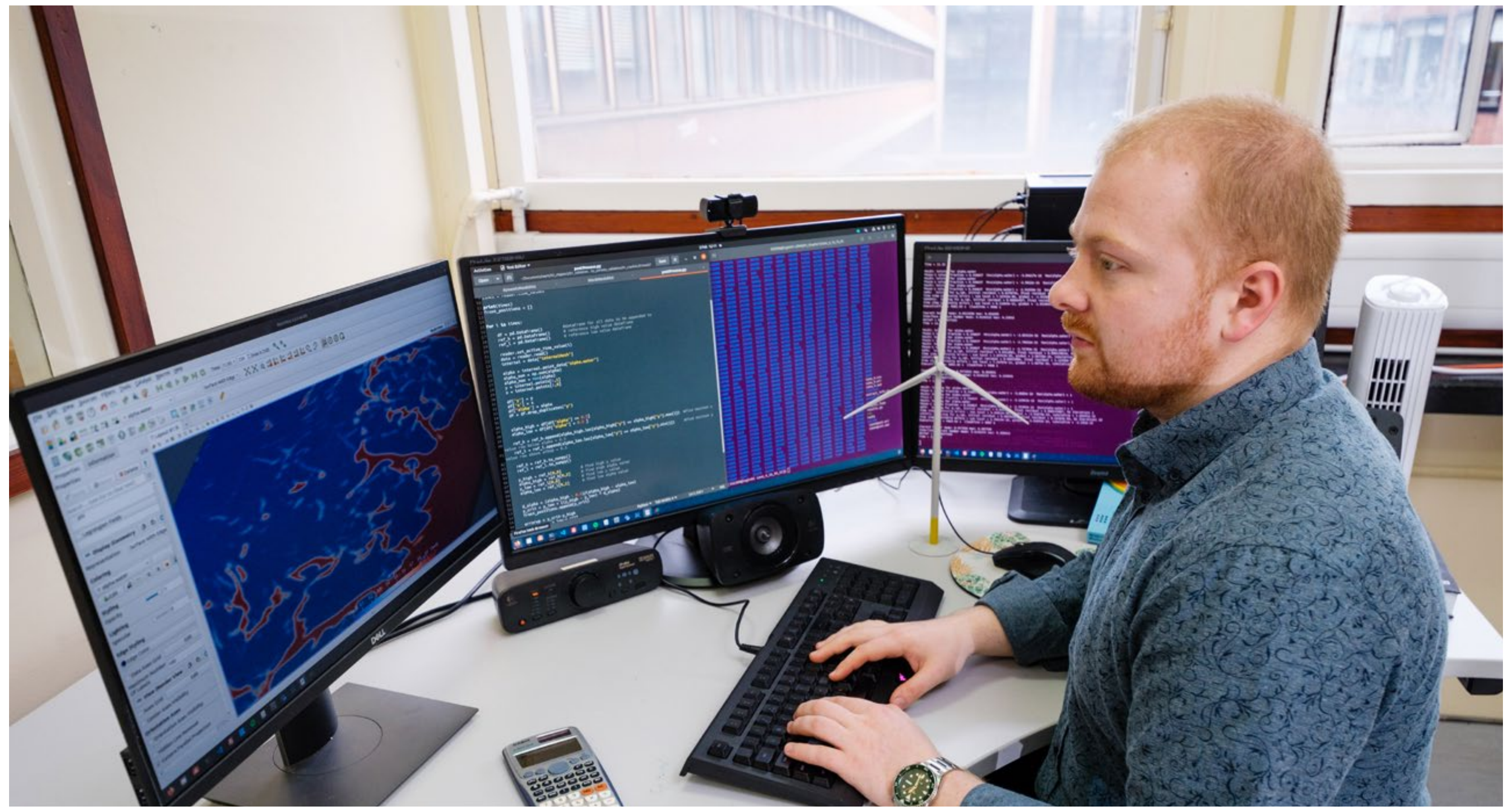
SIEMENS Gamesa RENEWABLE ENERGY

Postgraduate Researcher: Oliver Morgan-Clague
Supervisors: Prof. Jim Gilbert, Dr Rob Dorrell, Dr Peter Osborne, Soeren Hendrichson

Wind turbine blades are some of the largest composite structures currently manufactured, and they continue to increase in size and sophistication as offshore wind energy demands grow. The improvement in manufacturing quality and efficiency of turbine blades is vital to ensuring a cleaner and sustainable offshore wind industry.

The blades are manufactured from composites with glass/carbon reinforcement and epoxy resin matrix. The infusion of resin into the blade mould is governed by complex and interacting flow, thermal and chemical processes, some of which are not fully understood. Therefore, the aim of this PhD is to investigate and model the interaction of these internal structures with the infused epoxy and quantify its effects on blade manufacture. In doing, so we will reduce manufacturing waste and increase lifespan of functional turbines.



Next generation materials and manufactuing

Evaluating the impact of motion travel on cognitive ability of offshore workers - a VR experience

Postgraduate Researcher: Lisa Somerville
Supervisors: Dr Peter Robinson,
Prof. Fiona Earle, Dr David Smith, Ben George

Working on offshore wind turbines can provide many challenges to the individual, not least a long boat journey out to the platforms. This can potentially induce nausea, light-headedness and dizziness amongst other ill-effects, especially in rough weather conditions. In turn, this can lead to journeys being curtailed, resulting in wasted resources and loss of power generation.

We are using measures such as the NASA-TLX (Task Load Index), a proven diagnostic tool for evaluating the task performance of an individual or team. We are measuring the impact of journeys in varying weather conditions through Virtual Reality and Motion System simulation. From this, we will evaluate the effect that these journeys can have on short-term cognitive ability to undertake work tasks. This work will help us understand the conditions that impede performance. The knowledge gained in these studies will then allow us to explore VR solutions that could be utilised by workers as they travel to sites to mitigate these effects. Using VR technology such as the self-contained oculus quest, technicians would be able to don the headsets before beginning their journey, and through specifically tailored stimuli, it may be possible to counteract the effects of vessel motion.

Operations, maintenance and human factors

Enhanced mixing of stratified waters by offshore wind infrastructure

Postgraduate Researcher: Nilotpal Dhar
Supervisors: Dr Rob Dorrell,
Dr Stuart Mclelland, Dr Charlie Lloyd,
Dr Simon Waldman, Dr John Walker

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CATAPULT Offshore Renewable Energy

Whilst offshore wind developments to-date have predominately been constructed in well-mixed unstratified coastal waters, growth of the offshore wind sector now requires the first ever large-scale industrialisation of deeper, stratified water. Rapid growth and deployment into these new environments are both essential for meeting the UK's 2050 net zero carbon commitments. Therefore, it is vital that environment-engineering based solutions are developed now to enable sustainable and rapid large-scale expansion of offshore renewable energy into stratified shelf seas.

New understanding of turbulent mixing in stratified flow past infrastructure is required to aid both future design and to quantify environmental impact, from single turbine to array scale. To address these challenges, this project is developing local scale oceanographic computational fluid dynamic models of turbulent mixing in offshore windfarms. Models will then be used to quantify environmental impact and imposed loads from stratified flow past different offshore wind infrastructure.

Physics and Engineering of the offshore environment

Scour protection and the test tank of secrets

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hr wallingford

Postgraduate Researcher: Maisy Bradbury
Supervisors: Dr Stuart McLelland, Dr Robert Dorrell, Dr Kerry Marten, Prof. Richard Whitehouse

Offshore wind infrastructure is frequently exposed to large wave and fast current conditions, which can result in erosion (scour) of mobile sediments where the foundation structure meets the seabed. The erosion and removal of sediment can expose part of the foundation and cause a reduction in the lateral load capacity of foundations. In extreme circumstances, this can result in the wind turbine being shutdown to prevent feedback mechanisms from causing damage to the structure itself.

In this project, we are comparing different approaches to providing scour protection for different types of foundation, to quantify the performance and level of protection offered. In addition, the project investigates potential changes in scour protection through the lifecycle of an offshore wind installation, focusing in particular on potential scour protection failure mechanisms and the ease of decommissioning associated with different types of scour protection.

Blade Factory Digital Twin for Recording and Analysing Production Parameters

Postgraduate Researcher: Ewan Norris
Supervisors: Dr Peter Osborne, Prof David Wagg, Prof Jim Gilbert, Dr Steven Balding

Improving the quality and consistency of blade manufacture is critical in minimising the cost of wind energy. Blades are manufactured in SGRE's Hull facility through a number of complex manual and machine-based processes. To advance the sustainability of the blade manufacturing, we are creating a digital twin of the entire factory floor. The twin is the digital representation of the processes and procedures within the manufacturing environment, displayed and modelled as close to real time as possible. As such, the digital twin will combine the many and complex data streams inside the factory environment into a single simulation; from that simulation, data can then be monitored to help improve machine or process efficiencies, reduce safety risks and other logistical improvements.

Big data, sensors and digitalisation

Aura Doctoral Training

Shaping a sustainable future, training future leaders

Working collaboratively with our industry partners, academic community, and with each other, the Aura CDT postgraduate researchers are developing innovative and sustainable solutions to the global challenges facing the offshore wind energy sector with real world impact.

"The Aura CDT is a really powerful quartet of universities.. there's this real buzz of industrial universities coming through with some great thinking and I think it's a very powerful combination"

Jane Cooper, RenewableUK

Watch the film

Find out more at auracdt.hull.ac.uk

Contact us at auracdt@hull.ac.uk