



Aura Centre for Doctoral Training Conference in Offshore Wind and the Environment

20 – 21 September 2021

auracdt.hull.ac.uk

Led by:

**UNIVERSITY
OF HULL**

In partnership with:



Funded by:



Welcome from our hosts



I am delighted to be welcoming you to our very first Aura CDT Annual Conference. The Aura Centre for Doctoral Training in Offshore Wind Energy and the Environment was awarded by UK Research and Innovation (EPSRC-NERC) in 2018 and recruited its first cohort in 2019. In partnership, Hull, Durham, Sheffield and Newcastle Universities have grown the programme, which has now recruited 42 PhD candidates. Helping to deliver on the Offshore Wind Sector Deal and in partnership with our industry partners, we are exploring real-world solutions to global issues of clean energy and sustainable living.

Through the programme, we strive to develop future leaders in Offshore Wind Energy who are able to understand and prioritise a sustainable future. The programme is deeply rooted in EDI principles, in recruiting a diverse cohort, and creating an inclusive and supportive learning environment, which enables the growth and development of tomorrow's leaders. At this conference you will hear from current leaders in offshore wind from academia, industry and government, and our future leaders – their plans and ongoing research, their ideas and their solutions.

After working through these challenging times during the global pandemic, we are very excited to be once again hosting an in-person event. Taking lessons learned from the past 18 months, we are also pleased to take the opportunity to include colleagues further afield by offering a fully integrated hybrid event.

I warmly welcome you today and hope that you enjoy hearing the cutting-edge research undertaken within the centre by our students, colleagues and partners.

Professor Dan Parsons,
Director, Aura CDT and the Energy & Environment Institute,
University of Hull

Led by:



In partnership with:



Funded by:



Aura CDT in Offshore Wind Energy & the Environment Annual Conference

Venue: Aura Innovation Centre, Hessle

DAY 1 Monday 20th September 2021

Registration

09:00 – 09:30 **Registration and breakfast**

Welcome

09:30 – 09:45 Welcome Speech

Professor Dan Parsons, Director of Aura Centre for Doctoral Training, University of Hull

09:45 – 10:15 **Industry speaker** – Lauren Little, Stakeholder Advisor for Ørsted

Title: **The hidden world of offshore wind: A chance to change the future from your hometown**

10:15 – 11:00 Discussion stations, Main Foyer

BREAK

11:00 – 11:30 Mezzanine and Main Foyer

Presentation Session 1 - Theme: On the seabed

11:30 – 12:15 Chair: Sarah Bee

Maisy Bradbury, **'Testing scour mitigation measures,'** University of Hull

Jason Harrison, **'Fibre Optic Sensing for Cable Lifetime Performance Monitoring'** University of Hull

Ellie-Mae Cook, **'Cumulative impacts on ecological resources,'** University of Hull

CHANGE OVER

Presentation Session 2 - Theme: Under water

12:15 – 13:00 Chair: Emily Settle

Ethan Clark, **'Integration of seaweed aquaculture around offshore wind farms,'** Newcastle University

Gemma Hoyes, **'Satellite detection and mapping of sandbank crests,'** Newcastle University

Sarah Dickson, **'Acoustic monitoring of dolphins and porpoise,'** Newcastle University

LUNCH

13:00 – 14:00 Mezzanine and Main Foyer

Presentation Session 3 - Theme: In the air

14:00 – 15:00 Chair: Daniel Whitt
Sarah Bee, **'Advanced data analysis and robust statistics for structural health monitoring of wind turbines,'**
University of Sheffield
Oliver Morgan-Clague, **'Numerical modelling of wind turbine manufacture,'** University of Hull
Paul Hambly, **'Condition monitoring of generators and bearings,'** University of Sheffield
Harry Burton, **'Low power high performance neuromorphic circuits for turbine blade fault detection,'** University of Hull

BREAK

15:00 – 15:30 Mezzanine and Main Foyer

Presentation session 4 - Theme: Around a wind turbine

15:30 – 16:30 Chair: Hannah Marsden
Lisa Somerville, **'You make me sick: motion sickness in the human body and leading theories as to its causes,'**
University of Hull
Victoria Bessonova, **'Climate change impacts on offshore wind industry,'** University of Hull
Ben Pickett, **'Tsunami risk to offshore wind infrastructure,'** University of Hull
Woolaganathan Naidoo, **'Economic and social impact on fisheries,'** University of Hull

CHANGE OVER

Presentation session 5 - Theme: Grid integration

16:30 – 17:15 Chair: Ethan Clark
Daniel Whitt, **'Wind Sourced Energy Storage'** University of Hull
Siti Hamzah, **'Linking multiple wind farms in a supergrid,'** Durham University
Emily Settle, **'Using Digital Twins to create a coordinated energy supply,'** Durham University

CLOSING

17:15 – 17:45 **Closing Summary**
Professor Dan Parsons, Director, Energy and Environment Institute

DAY 2 Tuesday 21st September 2021

Registration

08:45 – 09:15 **Registration and breakfast**

Plenary: The Role of the Offshore Wind Sector in Tackling Climate Change

09:15 – 09:20 **Welcome**, Professor Dan Parsons, Director of Aura Centre for Doctoral Training, University of Hull

09:20 – 09:45 **Keynote Speaker** – Danielle Lane, Vattenfall
Title: **Offshore Wind Sector Deal: progress and future opportunities.**

09:45 – 10:00 **Guest Speaker** – Jo Burgess, Innovate UK
Title: **Importance of our People and Skills – inspiring and enabling talented people and teams**

10:00 – 10:15 **Guest Speaker** – Professor Deborah Greaves, Director of ORE Hub at SuperGen, Professor of Ocean Engineering and Director of the COAST at Plymouth University
Title: **The Supergen ORE Hub**

Plenary Discussion Panel

10:15 – 11:00 **Topic: How can we grow the right talent needed to deliver the OSW sector deal?**

Chair: **Louise Smith**, Director of Aura

Panel: **Prof Dan Parsons**, Director of Energy and Environment Institute

Danielle Lane, Vattenfall, Head of Asset Value and Partnering and Chair of OWIC

Jo Burgess, Innovate UK, Head of Innovation Talent Skills

Prof Deborah Greaves, Director of ORE Hub at SuperGen, Professor of Ocean Engineering and Director of the COAST at Plymouth University

Prof Jim Fleming, EPSRC, Head of Energy Themes

BREAK

11:00 – 11:30 Mezzanine and Main Foyer

Session 1: Energy Systems

11:30 – 12:45 Chair: **Dr Peter Osborne**, AMRC, University of Sheffield

Presenters: Rachael Keskake, **Incorporation of Energy storage into offshore wind farms for load levelling and energy security**, University of Sheffield

Favah Mobahriz, **Wind to Hydrogen and ePTA: Chemical Manufacture through Electrolysis**, University of Hull

Dr Behzad Kazemtabrizi, **Large-scale Offshore Wind Energy Integration (Reliability and Operation)** Durham University

Dileep Padinharu, **High Torque Density Permanent Magnet Vernier Machines for Direct-Drive Offshore Wind Turbines**, University of Sheffield

Dr Richard Williams, **Remote monitoring of wind turbine gear oil**, Durham University

LUNCH

12:45 – 13:45 Mezzanine and Main Foyer

Industry

13:45 – 14:15 **Andrew Elmes, Head of Business Development – UK&I, Siemens Gamesa Renewable Energy**
Title: **Surfing the Winds of Change**

Session 2: Sustainability

14:15 – 15:30 Chair: **Dr Nikos Dervilis**, University of Sheffield
Hannah Marsden, **‘From textile waste to advanced carbon material for offshore wind turbine blades’** University of Hull
Dr Waseem Tahir, **‘Challenges involved in the digitalization of manufacturing of Wind Turbine blades’**, University of Hull
Dr Asimina Manta, **‘Simulation and Design methods for novel composite wind turbine blade’** University of Sheffield
Prof Lizzy Cross, **‘Physics-informed machine learning for wind turbine health monitoring’**, University of Sheffield
Aidan Duffy, **‘An analytical model for predicting the leading-edge coverage of erosion’**, Durham University

BREAK

15:30 – 16:00 ***Turning the Tide* project demonstration**, Main Foyer – Dr Christina Roggatz (EEI, University of Hull) & Fred Garland (Tenfoot Dance Company)

Session 3: The Marine Environment

16:00 – 17:15 Chair: **Professor Jim Gilbert**, University of Hull
Jordan Burgess, **‘Wind farm associated noise and commercially important invertebrates’**, University of Hull
Niall Tracey, **‘Novel Acoustic Methods for Directly Monitoring Seabed Sediment Transport, Geo-hazards & Scour’**, Durham University
Sophie Al-Mudallal, **‘Impacts of offshore wind associated noise and vibration on infaunal invertebrates’**, University of Hull
Dr Evodokia Tapoglou, **‘Machine learning and remote sensing for wave simulation and forecasting in Offshore wind farms’**, University of Hull
Dr Agota Mockute, **‘Enabling sustainable exponential growth of offshore wind, built on UK-based NERC research’**, University of Hull

BREAK

17:15 – 17:45 PhD Research Showcase, Mezzanine

CLOSING

17:45 – 18:00 **Closing Summary**
Professor Dan Parsons

Day 1- Discussion Stations

Guests at the conference will be provided with a group number. During this session, each group will circulate around the discussion stations, spending approximately 5mins at each station.

Each station will cover a different topic relating to offshore wind energy:

1. Innovation road map, what came first?
2. A guess the stat? game of EDI trends
3. Which is higher?
4. Myth busting!
5. Where are the wind farms?
6. Environmental impacts
7. Top impact/concerns of the general public
8. Transferable skills in OSW energy



Day 1: Industry Speaker

Lauren Little – Industry Speaker
Stakeholder for Ørsted in Grimsby

Presentation title: The hidden world of offshore wind: A chance to change the future from your hometown

Lauren Little is a Stakeholder Advisor for Ørsted in Grimsby and engages with keystakeholders about the transformational impact that the offshore wind industry is having on the town of Grimsby and the wider Humber region.

Ørsted currently operate 4 offshore wind farms from the East Coast Hub in Grimsby and are currently constructing the world's largest offshore wind farm; Hornsea Two. Raising awareness of opportunities, inspiring young people into offshore wind careers and communication with businesses, local government, membership organisations and education are big parts of her daily work.

Most recently, Lauren supported the development of the Humber Offshore Wind Cluster prospectus and the £1million investment into the Youth Zone in Grimsby.



Image credit: Ørsted

Day 2 - Guest Speakers

Danielle Lane – Keynote speaker

Head of Asset Value & Partnering, Vattenfall

Presentation title: Offshore Wind Sector Deal: progress and future opportunities

Danielle is Head of Asset Value & Partnering for Vattenfall's Offshore Wind business unit with responsibility for transactions, revenue management, asset management and risk. Before taking this role in May 2021, she led Vattenfall's offshore market development with responsibility for developing the offshore wind pipeline in core markets and revenue opportunities to support subsidy-free projects. She joined Vattenfall in 2018 in its London office and is also Vattenfall's UK Country Manager bringing 20 years' experience in offshore wind, energy policy and regulation.



Danielle previously worked for Ørsted where she headed their UK regulatory and public affairs team, leading engagement with UK Government for the first CFDs awarded to UK offshore wind projects. Prior to Ørsted, Danielle worked at The Crown Estate where she had responsibility for design and implementation of the Round 3 offshore wind leasing tender and Centrica where she was Project Manager for the Round 2 offshore wind farms.

Danielle was educated at Imperial College and the University of Bath and holds an MBA from Open University.

Jo Burgess – Guest Speaker

Head of Innovation Talent and Skills for Innovate UK

Presentation title: Importance of our People and Skills – inspiring and enabling talented people and teams

Jo's expansive career has enabled her to work at the cutting edge of workforce development. From leading workforce transformation in local government to launching England's first Degree Apprenticeship in Data Science, Jo has had the privilege of developing strategies and initiatives which have made a real and significant difference to organisations, businesses and people. Jo now leads Innovate UK Talent and Skills Policy Team, tasked with addressing key government priorities within the BEIS Innovation Strategy to ensure interventions provide businesses with the skills they need, by developing the UK's workforce and attracting and retaining global talent.



Professor Deborah Greaves – Guest Speaker

Head of the School of Engineering, Computing and Mathematics, Professor of Ocean Engineering and Director of the COAST Laboratory at the University of Plymouth

Presentation Title: The Supergen ORE Hub

Deborah Greaves is Head of the School of Engineering, Computing and Mathematics, Professor of Ocean Engineering and Director of the COAST Laboratory at the University of Plymouth with previous appointments at the University of Oxford, UCL and the University of Bath. Her research interests include marine and offshore renewable energy, and physical and numerical modelling of wave-structure interaction. She has led many national and international research projects concerning offshore renewable energy (ORE) in collaboration with industrial and academic partners and is Director of the EPSRC £9 million Supergen Offshore Renewable Energy (ORE) Hub.

In the Queen's Birthday Honours List, 2018, she was awarded an OBE for services to Marine Renewable Energy, Equalities, and Higher Education and in 2020, she was elected to be a Fellow of the Royal Academy of Engineering.



Andrew Elmes – Industry Speaker

Head of Business Development - UK&I, Siemens Gamesa Renewable Energy

Presentation title: Surfing the Winds of Change

Andrew has recently assumed the role after fulfilling the Turbine Supply Agreement for Scottish Power's East Anglia ONE offshore windfarm.

From a military engineering background, Andrew first joined Siemens Wind Power in 2007, project managing UK onshore windfarms as well as establishing the first UK project and construction teams.

After a brief emigration to Australia, he returned to Siemens in 2015 to lead the port and preassembly development for Siemens Gamesa's flagship Port of Hull facility, before heading up the EA1 team, on a project that saw the first scale deployment of 66kV electrical design, as well as completing through the CV-19 pandemic.



Plenary discussion

We welcome our keynote speakers to the plenary discussion, joined by Dr Jim Fleming (EPSRC), Prof Dan Parsons (University of Hull) and Louise Smith (Aura).

Dr Jim Fleming – Plenary Discussion Panel member

Head of the Energy Theme, EPSRC

Dr Jim Fleming has a degree and PhD in Chemistry from the University of Bristol.

After a few years of post-doctoral work, he joined EPSRC at the end of the last millennium.

He has worked in a variety of roles across EPSRC before becoming Head of the Energy Theme in 2017.



The Aura CDT – challenge focused to meet the needs of the Offshore Wind Sector

Research development & innovation

Identifying and solving the technical challenges and problems facing the offshore wind sector, now and ten years down the line. Through co-created programmes of research, development and innovation the Aura CDT helps build a vibrant and successful industry.

Engagement with industry

Engaging extensively with industry and wider stakeholders over the long-term to actively contribute to future sector plans. We build and grow existing relationships to support economic growth through the essential development of a strong supply chain.

Creating a talent pipeline

Understanding and meeting the skills need of the Offshore Wind Industry. We develop the talent, skills and expertise needed by the offshore wind sector, across a diverse cohort of exceptional students. Contributing to the creation of a vibrant, mature and sustainable offshore wind industry.

Day 2 – Session 1: Energy Systems

Dr Behzad Kazemtabrizi, Durham University

Dr Kazemtabrizi is associate professor in Electrical Engineering in the Department of Engineering at Durham University. He is a Senior Member of the Institute of Electrical and Electronic Engineers (IEEE) and a Fellow at Durham Energy Institute. His principal research interests are in advanced energy systems modelling, for improving operability and reliability of power systems.

His research encompasses a wide range of topics focusing on reliability evaluation and optimisation of power systems operation, and large-scale wind energy integration. To date, he has had the pleasure of being involved in several collaborative projects including UKRI projects (SUPERGEN-Wind, HOME-Offshore) as well as Industry funded projects.



Dr Richard Williams, Durham University

Richard Williams is a researcher at Durham university and the work is part of the EPSRC Prosperity Partnership, a New Partnership in Offshore Wind consortium. The project partners are Durham University, Ørsted and C.C.Jensen.

The aim of this work is to understand the role condition monitoring of gearbox oil can play in the operation and maintenance of an Offshore wind turbine. Online oil cleanliness and oil health Instrumentation has been installed on several wind turbines and the data is being analysed. The data gives information on the condition of the oil, the condition of the lubricated components and the state of the filtration system.



Dileep Padinharu, University of Sheffield

Dileep Kumar Kana Padinharu received his B.Tech in electrical and electronics engineering from College of Engineering Trivandrum, Kerala India in 2004 and MSc (Eng) in high voltage engineering from India Institute of Science Bangalore, India 2007.

He worked for General Electric Company in India from 2007 to 2017, where he was involved in designing high power synchronous generators. Currently he is pursuing PhD in Electrical engineering from the University of Sheffield his research interests are design, modelling and optimisation of permanent magnet machines.



Day 2 – Session 2: Sustainability

Dr Mohammad W Tahir, University of Hull

Currently working with the embedding of sensors for lifetime monitoring, transportation as well as operation of industrial wind turbine blades; in collaboration with Siemens Gamesa Renewable Energy (SGRE), Ørsted, Sheffield and Durham Universities. Mohammad is also working on the project to optimise the manufacturing process of wind turbine blades in collaboration with SGRE.

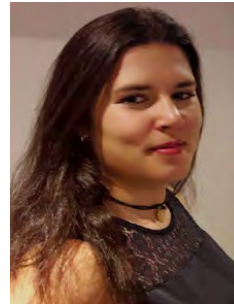
He has 11 years of experience of working in automation and manufacturing industry as well as in academia. His PhD is in Aerospace Engineering—lightweight structures—from KTH University, Sweden. He Has experience of developing new manufacturing techniques for the automobile industry. Previously, was involved in research projects in collaboration with Toray Japan, RISE Sweden, Volvo, Scania, KTH University and Lulea University.



Dr Asimina Manta, University of Sheffield

Asimina Manta is a Research Engineer in the Simulation/Analysis group within AMRC Composite Centre. She has obtained her PhD on the numerical simulation of the multiphysics response of graphene/polymer nanocomposites, from the University of Manchester, UK, and has graduated from the Department of Mechanical Engineering and Aeronautics at University of Patras, Greece, with first class honours degree (diploma). Asimina is currently working on the design and optimisation of composite structures through numerical methods (finite element simulations). She is leading the simulation projects on advanced wind blade composite structures and the design optimisation for zero-material waste.

Her research interests are expanding on every aspect of composite material simulation, including design optimisation, structural analysis, thermal and electrical composite performance, microwave/laser curing, nanocomposite materials and full-field model validation.



Aidan Duffy, Durham University

Aidan Duffy is a PhD student at Durham university working alongside project partners at Ørsted and Siemens Gamesa Renewable Energy as part of the Prosperity Partnership: A New Partnership in Offshore Wind.

His research is focused around understanding, quantifying and improving predictions of leading edge erosion and associated annual energy production losses of offshore wind turbines.

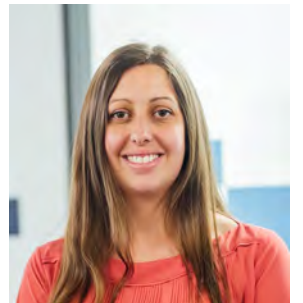


Professor Elizabeth Cross, University of Sheffield

Professor of Structural dynamics Lizzy Cross is a Professor in the Dynamics Research Group at the University of Sheffield, specialising in data-driven structural assessment.

Before starting her lectureship in 2012, she completed a Bachelors in Mathematics (1st class), and Masters and PhD in Mechanical Engineering. She currently holds an EPSRC Innovation Fellowship on the development of grey-box models for assessing the health of structures in operation (grey-box models combine physics-based models with machine learning technology).

Lizzy is a co-director of the Laboratory for Verification and Validation, a state-of-the-art dynamic testing facility.



Day 2 – Session 3: The Marine Environment

Dr Evdokia Tapoglou, University of Hull

Dr. Evdokia Tapoglou is a Post-doctoral Research Associate in the Energy and Environment Institute at the University of Hull.

She obtained her Ph.D. from the Technical University of Crete in Environmental Engineering working on machine learning methodologies for Environmental parameter simulation.

In the last couple of years, she has been working on SmartWave, a novel methodology that is capable of simulating the state simulation in offshore wind farms at a high resolution.

Her research interests include Machine learning for Environmental parameter simulation, wave simulation for offshore wind farms, as well as examining climate change adaptation and mitigation strategies.



Dr Agota Mockute, University of Hull

Dr Agota Mockute is a NERC Knowledge Exchange Fellow at the Energy and Environment Institute in the University of Hull.

She is focussing on knowledge exchange between the key stakeholders in offshore wind and the natural environment, to identify key research priorities and capabilities to enable sustainable expansion of offshore wind in order to meet the Net Zero emissions targets.

Agota's expertise through her international PhD and further research work focusses on wave loading on monopile-supported offshore wind turbines in rough seas, and the effect of highly nonlinear resonant phenomena on the structural response and remaining useful lifetime.



Turning the Tide:

A dance-performance-film project exploring the role of women in the renewable energy and offshore wind sectors

**Dr. Christina C. Roggatz (EEI, University of Hull)
& Fred Garland (Tenfoot Dance Company)**

Women are still severely underrepresented in engineering professions, despite growing skills shortages and ambitious gender targets as highlighted in the recently published 'Equality, Diversity and Inclusion (EDI) in Engineering' report by the AURA team in collaboration with SUPERGEN ORE.

Aiming to inspire a non-typical target audience to aspire to a STEM career, this project explores the role of women in the renewable energy and offshore wind sectors to produce a creative, performance-based film and podcast for exhibition.

Facts and insights from case studies will be translated into choreography and filmed while being performed by a group of female local community volunteers in different topical locations. The project will form part of artist Fred Garland's national project 'Women's movement 100 – Angels of the North' and we present the project plan, give a first taste of what Hull's part might look like and highlight ways in which students, staff and industry partners can get involved.



Meet our PhD Researchers: Cohort 1

Sophie Al-Mudallal, University of Hull

Research project: **Impacts of Seabed Vibration on Sediment Structure and Infaunal Organisms**

My PhD project aims to investigate the impacts of offshore wind related noise on sediment dwelling (benthic) marine invertebrates, an area of knowledge that is yet to be researched. With constantly increasing numbers of offshore wind developments, it is imperative to understand how the anthropogenic noise from turbine installation and operation may affect benthic invertebrates and ways in which impacts may be prevented. Benthic invertebrates provide the foundation of marine ecosystems globally and are vital to the biodiversity and conservation of the marine environment.

Laboratory-based experiments to study how these organisms are affected by simulations of short and long-term exposure to offshore wind noise and vibration will further the understanding of cumulative impacts. Any impacts or changes to sediment structure will also be studied, a vital factor in the behaviour and burrowing habits of benthic invertebrates. This research will help to gain insight into how offshore wind developments may adapt and account for the marine environment, increasing the sustainability of the offshore wind industry in the future.

Jordan Burgess, University of Hull

Research project: **The impacts of windfarm associated noise on commercially important invertebrates**

The impacts of underwater noise and species in the marine environment have been well studied for marine mammals and some fish species. However, when looking at species further down the food-chain, research becomes sparser. There are tens of thousands of marine invertebrates which underpin the food web for the larger species that gain much protection from regulations.

Bridlington is one of the largest ports for the European Lobster fishery in Europe, where landings made €4,200,000 in 2014. As more and more turbines are placed in the North Sea, noise is going to become a much bigger problem and have wider impacts on the more sessile species such as marine invertebrates. The impacts of noise may result in shorter term behavioural changes or longer-term physiological problems which will cause a greater economic problem in terms of lobster catches and their subsequent price per unit weight.

My study will look at the effects, both short and long term, on commercially important invertebrates and the impacts that wind farm associated noise will have on these organisms. This may fall under two types of noise: impulsive through the installation and decommissioning and more continuous noise vibration during operation.

Rachael Keslake, University of Sheffield

Research project: **Incorporation of Energy storage into offshore wind farms for load levelling and energy security**

My PhD project is concerning the integration of energy storage solutions into floating wind turbines. This will involve consideration of all potential solutions already available for energy storage and how they can fit in with the design specifications of a floating turbine.

Once a specific energy storage has been chosen as both having high potential for integration and which is not already being extensively researched, work will focus on optimising and integrating the storage device with a floating turbine. This project aims to therefore make floating wind turbines more viable and efficient as energy sources.

As the intermittency of wind is its major flaw as an energy source, supporting the turbine with energy storage will fill in the gaps of the wind supply. Integrating energy storage onto floating turbines thus makes the platform a more viable and efficient option. Floating turbines are needed in wind farms in countries such as Japan and USA who have quite deep coastlines, and this research will help in getting these turbines ready for operation.

Hannah Marsden, University of Hull

Research project: **From textile waste to advanced carbon materials for wind turbine blade manufacturing**

My PhD will involve taking waste clothes and recycling them to produce carbon nanomaterials, such as fullerenes and carbon nanotubes. Thermal chemical vapour deposition will be used to produce these, and research into the most efficient parameters will be carried out.

Once the Carbon materials are collected they will either be electrospun with polymers to produce a reinforced polymer, or impregnated with a polymer matrix. This will be explored to determine the most efficient approach, as well as which will be the best approach for load transfer.

Following producing carbon reinforced polymers they can be used in manufacturing for the production of wind turbine blades. The project will also cover managing the purity of the carbon nanomaterials produced, using various analytical methods such as scanning electron microscopy and x-ray diffraction.

Favad Mobahriz, University of Hull

Research project: **Wind to Hydrogen and ePTA: Chemical Manufacture through Electrolysis**

The project has a focus to utilise intermittent electricity generated from offshore wind turbines to chemically transform para-xylene into purified terephthalic acid (ePTA) in water via ultrasonic emulsification electrolysis; simultaneously green hydrogen will be formed as a by-product of the chemical reaction.

The project aims to replace existing methods to produce ePTA with more environmentally aware methods; ePTA is highly sought-after commodity which is expected to increase in market value from \$48.8 Billion (2020) to \$62.1 Billion (2027), this as a result also helps to offset the costs associated with electrolysis of water.

Niall Tracey, Durham University

Research project: **Novel Acoustic Methods for Directly Monitoring Seabed Sediment Transport, Geohazards & Scour**

My PhD aims to develop and field test novel acoustic methods for directly monitoring and understanding the processes of seafloor sediment transport and scour. These seabed processes can be a significant geohazard to offshore wind installations and their seabed power cables, telecommunication cables, oil and gas pipelines and other strategic seafloor infrastructure.

During the PhD, I will firstly perform calibrated flume experiments to understand what determines the nature of acoustic signals emitted by seabed sediment transport or erosion processes. Then I will interpret acoustic field data to better monitor and understand seabed sediment transport and scour processes occurring around offshore wind monopiles. Afterwards, I will analyse a series of hydrophone field data sets. To show how hydrophones can be used to detect and understand hazardous seabed flows, which could become a future hazard for floating offshore wind farms.

Meet our PhD Researchers: Cohort 2

Sarah Bee, University of Sheffield

Research project: **Advanced data analysis and robust statistics for structural health monitoring of wind turbines: from individual components to a fleet.**

This project seeks to advance how the collected data from wind turbines is processed using machine learning algorithms. The health state of individual turbines and the wind farm as a whole could then be assessed in near real-time with improved accuracy. This improvement to structural health monitoring could maximise the performance of current turbines and be used in the design of future turbines.

Maisy Bradbury, University of Hull

Research project: **Dynamics of turbulent wakes in multiphase flows**

The rapid expansion of the offshore wind industry has caused an increase in demand to assess the impact that subsurface structures can have on the environment. By the end of 2020 monopiles remain the most used foundation structure with 81% of European turbines installed with monopile foundations. However, a number of hydraulic issues can arise when these are placed on the seabed, one of these been scour.

Scour is the erosion of the seabed around a turbine monopile foundation, the fluid forms vortices which erodes the sediment leaving a scour hole. The removal of sediment weakens the structure and exposes cables, it is important to mitigate against scour on monopiles as for a wind turbine the foundations can account for up to 35% of the total installed cost and these costs will want to be controlled and minimised.

Using physical models within test tanks [my] [Maisy's] research will investigate scour development around a monopile to understand the characteristics and ways in which this can be mitigated by either modifying the flow and not create hard boundaries and shear zones or softening the shear zone. This work will be carried out in partnership with HR Wallingford.

Harry Burton, University of Hull

Research project: **Low Power High Performance Neuromorphic Circuits for Remote Sensing and Monitoring in the Offshore Wind Sector**

My project is concerning the operation and maintenance of the blades of a wind turbine. This will involve the design and concept of novel low powered high-performance neuromorphic circuits for aiding wind turbine blade monitoring. This will be done using a relatively new circuit element called a memristor to act as a synapse in a neural network that will be able to take input signals from sensors on the turbine blade and make a prediction as to when the blade will encounter a fault such that predictive maintenance can be performed, reducing the cost of operation.

The operation and maintenance are a large expense in the life of a wind turbine, and so making accurate predictions to when a blade will fault can lead to significant savings, reducing the costs for a wind farm and brining the cost of electricity down.

Ethan Clark, Newcastle University

Research project: **Assessing the viability of multi-use Macroalgae Aquaculture within Offshore Wind Farms**

Macroalgae aquaculture has demonstrated its ability to sequester a huge amount of carbon while also boosting biodiversity through the provision of nursery habitats, food, and shelter to a variety of native and commercially important organisms. If this ability can be upscaled and optimised, there is potential to develop highly productive areas of the ocean which sink a huge amount of carbon at the same time.

Multi-use is the colocation of industries in a single space to enable the sharing of costs, infrastructure, and operations. This project examines the viability of colocation of commercial macroalgae aquaculture and offshore wind to efficiently sink carbon on a large scale, outlining the benefits and challenges that must be overcome.

Ellie-Mae Cook, University of Hull

Research project: **Cumulative and in-combination effects of offshore infrastructure on ecological resources**

The offshore wind industry is rapidly developing in line with global targets and the movement against climate change. Such rapid development of the offshore wind industry poses a significant threat to the marine environment, as infrastructure widely populates these areas.

Physical disturbances can lead to many implications amongst the marine environment but can specifically result in changes to the structure and functioning of benthic communities. Such benthic or seabed communities contribute disproportionately to the functioning of highly biodiverse coastal and shelf sea ecosystems.

This study will therefore aim to focus upon the tracking of changes amongst benthic resources within the North Sea. Including the likes of: species presence, creation of habitat and repercussions for ecological structure and functioning. Whilst also considering long-term, cumulative and in- combination effects of offshore infrastructure.

Sarah Dickson, Newcastle University

Research project: **Assessment of echolocating cetacean (porpoise and dolphin) occurrence and behaviour in offshore development sites using a novel passive acoustic monitoring system**

Sound is used by marine mammals to navigate, forage and communicate. Offshore renewable energy installations are contributing to the increase in anthropogenic generated noise. Therefore, these installations may impact upon marine mammal distributions, foraging and reproductive success.

Passive Acoustic Monitoring (PAM) can be used to detect the presence of vocalising marine mammals. NanoPAM is a novel low-cost PAM system designed at Newcastle University, which allows near real time spatial and temporal tracking of dolphins and porpoises. It also reduces the need for visual offshore surveys, reducing the overall costs of environmental surveys at offshore developments. This project aims to assess the occurrence and behaviour of porpoises and dolphins at offshore development sites using the NanoPAM system.

Paul Hambly, University of Hull

Research project: **Advance condition monitoring solutions for offshore wind generators**

Reliability and availability are two key requirements in offshore wind generators where a fault can result in catastrophic failures. Furthermore, any downtime caused by faults or maintenance results in significant loss of revenues. With the aim of reducing faults and increasing availability, there has been a recent upsurge of interest in real-time monitoring of machine health during its lifetime.

The aims are not only to avoid the risk of catastrophic failures but also to replace costly periodic routine maintenance with condition-based maintenance to be performed only when the remaining useful life (RUL) decreases below a predefined threshold. Industrial surveys have identified degradation in the electrical insulation in the generators and degradation in the bearings as the two most common causes of failure in high power electrical machines of the type used in offshore wind generators.

This project will investigate novel methodologies for a holistic solution to condition monitoring and prognosis of the remaining life of electrical generators and their bearings. Based on advanced signal processing methods and emerging methodologies for sensor fusion and machine learning, the project will develop novel detection methods for bearings and electrical faults that combine the available mechanical and electrical signals. It is expected that the approach developed will result in significant improvement in sensitivity to the detection of progressive degradation and incipient faults.

Gemma Hoyes, Newcastle University

Research project: **Satellite detection and mapping of sandbank crests: supporting location of offshore wind developments and conservation areas**

Offshore wind turbines and submerged sandbanks are commonly located in close proximity due to the urgent prioritisation of deployments. Improved monitoring of the sandbanks would enable a clearer understanding of the impact of this, as well as advancing our knowledge of offshore sandbanks in general. Satellite-derived bathymetry will enable us to identify and monitor the sandbanks, by using multi-spectral satellite imagery and empirical modelling. This will be beneficial for informing future environmental impact assessments and supporting ongoing monitoring.

Siti Khadjiah Hamzah, Durham University

Research project: **Modelling and Optimisation for a Coordinated interconnected multi-terminal DC transmission infrastructure for integration of offshore wind energy**

This work will involve developing advanced computational models for power systems including models that are suitable for solving optimal power flow problems. Models will be developed for **VSC-based HVDC links** which could be used to form **multi-terminal supergrids** for connecting multiple wind farms.

The **optimal power flow** problem, mathematically, is a nonconvex, nonlinear optimisation problem which can be quite tasking in its original form for especially larger scale systems and as such one of the main methodological contributions in this project is to develop suitable approximations such as linearisation methods for reducing the computational expenditure of the optimal power flow problem and at the same time maintain its tractability when scaled up for larger systems.

The project will also involve implementation of a suitable day-ahead operational planning framework by solving multiple instances of optimal power flow problem to plan the operation of offshore wind farms within a specific planning timescale (for example for 24 hours). The planning framework is then implemented to multiple wind farms connected via a multi-terminal HVDC supergrid to provide better power regulation and a more stable, reliable operation even after emergencies such as **loss of supply** in a specific region.

These added flexibilities of operation are necessary for a sustainable growth and integration of offshore wind resource in the future for example in the UK in line with **National Grid's Future Energy Scenarios (FES)** projections

Woolganathan Naidoo, University of Hull

Research project: **Economic and Socio-cultural implications of offshore wind on fishing communities**

Offshore wind is forecasted to grow significantly in the coming decades to combat climate change and for energy security. The influx of offshore wind technologies will impact fisheries socially and economically, therefore, perceptions of developers and interaction of fishery may help better understand these implications as different stakeholders view the sea differently. Like marine spatial planning and co-location, compensation is seen as a form of conflict mitigation but can have both negative and positive effects that varies across different fisheries and comes at a cost to offshore wind developers. This study will revolve around better understanding the economic and socio-cultural interactions between the two sectors.

Ben Pickett, University of Hull

Research project: **Palaeo record of Tsunami risk to Offshore Renewable Energy Infrastructure**

With an increasing reliance on offshore wind power for energy generation within the UK, the security of this generation method against natural hazards should be examined. Tsunamis are characterised generally as high magnitude, low frequency events, a characterisation that is further compounded by a perception of them only occurring at tectonic plate boundaries or other tectonically active sites.

Paleosedimentary records (Gaffney et al., 2020; NOAA, 2017) show that the North Sea and UK east coast have experienced tsunami and mega-tsunami events before. These events have been interpreted to have flooded coastal lowland regions that are now used for offshore turbine foundations (Walker et al., 2020), indicating that currently constructed sites are at risk from a potential tsunami.

This project intends to identify available tsunami deposits along the Yorkshire coast, from both soft sediment coring and (where available) core data taken directly from offshore wind sites, with the aim of examining the frequency and size of the events passing through the North Sea. The project then intends to utilise these estimations of size to simulate events in a laboratory scale experiment to determine the effects such events would have on the offshore wind infrastructure as a whole, and where possible trial appropriate damage mitigation strategies.

Emily Settle, Durham University

Research project: **Digital twins Era for Coordinating Energy Network inTegration (DECENT)**

In smart grids, grid inertia (typically provided by gas/steam turbine based synchronous generators) is a very important measure of power networks' stability. Low grid inertia will make power networks suffer from poor power quality and increased risk of blackouts. Massive offshore wind turbines however don't provide grid inertia due to the use of frequency converters between wind turbines and power networks.

This becomes one of the most challenging barriers for integrating more offshore wind energy sources into power networks in the research field of smart grids.

This project aims to develop digital twin technologies for coordinating wind turbines and energy storage units to provide virtual grid inertia, thus facilitating greater penetration of offshore wind in power networks.

Daniel Whitt, University of Hull

Research project: **Wind Sourced Energy Storage**

The world is in a climate disaster and we need to find a way to make wind energy production with as little wasted electricity as possible. Therefore, finding a green way to store this excess energy for times when production exceeds demand.

Electrolysis is the process of producing green hydrogen to then be stored in tanks or caverns. However, current electrolysis process is either not the most efficient or have issues with the electrodes. However potentially using nano technology could help with increasing the efficiency by removing the Electric Double Layer as well as taking advantage to some unusual properties that occurs to waters molecular behaviour when confined within nanocavities.

Therefore, looking into these properties and developing from them we could increase the rate green hydrogen to store the wind energy.

Meet our PhD Researchers: Cohort 2 Industry Scholarships

Victoria Bessonova, University of Hull

Research project: **The future of global offshore natural capital with climate change**

The research project is in partnership with Offshore Renewable Energy (ORE) Catapult. The PhD directly addresses sector needs to understand climate change and offshore natural capital, meaning the elements of nature that directly or indirectly produce value to people, and more specifically wind and wave conditions can help towards developing offshore renewable energy in a sustainable way.

The project will lead to a greater understanding of the impact of climate change in the offshore renewables sector and provide guidelines for operators, contractors, and stakeholders in all stages of the wind farm lifetime. From planning, to operation & maintenance and decommissioning this PhD will lead to futureproofing equipment, extending lifetime of infrastructure and timely decommissioning.

Jason Harrison, University of Hull

Research project: **Fibre optic sensors for cable lifetime performance monitoring**

This research project is in partnership with Offshore Renewable Energy (ORE) Catapult. The PhD directly addresses sector needs to understand power cable sensor design.

Failure and repair of array and export cables represent one of the largest costs for wind farm operators and are a focus for extensive research interest. There are varied root causes for cable failures, including stresses caused by seabed movement and free spans, overheating as a result of excess burial depth and excessive curvature during installation and burial, but these are poorly understood.

A particular focus will be on improving spatial resolution and resolving strain/curvature in 2 dimensions; which is important for understanding cable loading but is not currently possible. The research will develop a sensing approach, possibly combining distributed or discrete sensing schemes, to address the aforementioned issues. Research project activities will include modelling, design and fabrication of prototype sensors or sensing schemes and the cable structures needed to achieve the aims of the project.

Oliver Morgan-Clague, University of Hull

Research project: **Numerical modelling of wind turbine blade manufacture**

As the understanding of wind turbine manufacture and operational parameters have increased, so has the total length of the blade and complexity of the internal structures. The aim of this PhD is to investigate and model the interaction of these internal structures with the infusion epoxy and quantify its effects on blade manufacture in collaboration with Siemens Gamesa RenewableEnergy.

Lisa Somerville, University of Hull

Research project: **Evaluating the impact of motion travel on cognitive ability of offshore workers – a VR experience**

This research project is in partnership with Offshore Renewable Energy (ORE) Catapult. The PhD directly addresses sector needs to understand motion sickness effects on offshore technicians.

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 conditions, especially in rough weather conditions.

This project will look at measuring the impact of varying duration journeys in varying weather conditions through Virtual Reality and Motion System simulation. We will evaluate the effect that these journeys can have on short-term cognitive ability to undergo work tasks.

The project would lead to a greater understanding of the impact of sea travel on performance, but also allow for VR solutions that could be utilised by workers as they travel to sites. Using VR technology such as the self-contained oculus quest, users 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.

Aura CDT Research Themes

Unique dual focus on engineering and environmental challenges
Developed with stakeholders to serve industry needs:



**Physics and
Engineering of
the offshore
environment**



**Environmental
impact, marine
biology and
aquaculture**



**Next generation
materials and
manufacturing**



**Operations,
maintenance and
human factors**



**Offshore
wind energy
integration**



**Big data, sensors
and digitalisation**

Led by:



In partnership with:



Funded by:



Engineering and
Physical Sciences
Research Council



Natural
Environment
Research Council




UNIVERSITY
OF HULL

**Drawing on the expertise of
leading academics from
our research-intensive
partner institutions**




Durham
University




Newcastle
University




The
University
Of
Sheffield.



**Thank you for attending and
supporting the Aura Centre
for Doctoral Training**

Conference 2021

auracdt.hull.ac.uk

Led by:

UNIVERSITY
OF HULL

In partnership with:



Funded by:





Thank you for attending the Aura CDT conference
For further information:

auracdt.hull.ac.uk

aura-innovation.co.uk

hull.ac.uk/eei