PhD projects in Offshore Renewable Energy

Information provided correct as of June 2020

Sector	University (A-Z)	Title of PhD thesis	Financial support from industrial sponsor? (Y/N)	Description & key aims
Offshore Wind (OSW)	Cranfield University	Structural integrity assessment of functionally graded components created using additive manufacturing technology for marine applications	To be confirmed	To be confirmed
OSW	Cranfield University	Fatigue Performance of Bolted Connections of Offshore Wind Turbines	To be confirmed	To be confirmed
OSW	Cranfield University	Reliability of Structural Health Monitoring Technologies for Offshore Wind Turbine Support Structures under Uncertainty	To be confirmed	To be confirmed
OSW	Cranfield University	Investigating Computational Uncertainties and Their Effects on the Fatigue Life of Offshore Wind Turbine Foundations	To be confirmed	To be confirmed
OSW	Cranfield University	Operation and maintenance cost optimization of offshore wind farms using advanced financial models	To be confirmed	To be confirmed
OSW	Cranfield University	Characterisation of Influence of Thermal Cycle and Build Strategies on the Evolution of Microstructure, Mechanical, Fracture toughness and Corrosion Properties of Low Alloy Steels, Deposited Using WAAM Process	To be confirmed	To be confirmed
OSW	Cranfield University	Material Pre-Straining Effects on Fatigue and Fracture Behaviour of Offshore Wind Monopile Structures Foundations	To be confirmed	To be confirmed
OSW	Cranfield University	Very Large Wind Farm Design Improvement Using Multi-Fidelity Modelling Approaches	To be confirmed	To be confirmed
OSW	Cranfield University	Using Small Scale Mechanical Tests to Predict the Crack Arrest Properties of Modern Structural Steels	To be confirmed	To be confirmed
OSW	Cranfield University	Integrity Issues in high productive hybrid welding processes for marine structures	To be confirmed	To be confirmed

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OSW	Cranfield University	Corrosion Fatigue in Marine Structures	To be confirmed	To be confirmed
OSW	Cranfield University	The influence of residual stresses on structural integrity of renewable energy marine structures	To be confirmed	To be confirmed
OSW	Cranfield University	Structural Reliability of Offshore Wind Assets	To be confirmed	To be confirmed
OSW	Cranfield university	An assessment of natural capital at Thanet offshore wind farm	To be confirmed	To be confirmed
OSW	Cranfield University	Development of a Framework for the Effective Data Management of Structural Health Monitoring Systems for Offshore Wind Turbines	To be confirmed	To be confirmed
OSW	Cranfield University	Multi-objective and Multi-criteria Decision Making on Offshore Wind Farm Location and Support Structure	To be confirmed	To be confirmed
OSW	Cranfield University	Optimization of Structural Health Monitoring Systems through Integration of Technological and Analytical Methods	To be confirmed	To be confirmed
OSW	Durham University	Improving the Aerodynamic Performance of Offshore Wind Turbines, with respect to Blade Leading Edge Erosion.	Y	To quantify the impact of leading edge erosion on the annual energy production from offshore wind turbines. To investigate aerodynamic design changes to reduce the impact of erosion on aerodynamic performance. To assess the impact of blade erosion repair methods on aerodynamic performance.
OSW	Durham University	Numerical modelling of drag anchors for cable risk assessment.	Y	Development of software for modelling drag anchor embedment and for the prediction of ultimate holding capacity for a variety of soil types. Use the software to carry out parametric analysis of the sensitivity to key variables for emergency anchoring and for moored vessel anchor breakout.
OSW	Durham University	Improved assessment of installation risks and in-place stability of lightweight inter-array cables for offshore renewable installations.	Y	Development of a modelling methodology for the installation of lightweight offshore cabling and its use to produce guidelines for consultants and contractors engaged in cable-laying, maintenance and assessment.

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OSW	Durham University	Improved characterization of wind turbine blade damage from inspection images.	Y	To produce a validated methodology for improving the characterization of blade damage from inspection images captured from commercially available drones. To design and evaluate a range of sensing options and associated algorithmic analysis techniques to support the characterisation of blade damage in-situ.
OSW	Durham University	Robust power converter design for large scale wind turbine applications.	Y	Development of advanced converter solutions to enable cost effective deployment of large generators with greater robustness, fault-tolerance and reliability
OSW	Durham University	Offshore Transmission Systems Asset Management Under Severe Uncertainty.	Y	Development of novel power systems planning methods for applications in offshore wind transmission investment planning under severe uncertainty.
OSW	Durham University	Machine Learning & Data Mining with Big SCADA Data for Prognostic Modelling of Offshore Wind Turbines.	Y	Development of Engineering guided data mining algorithms for Wind Turbine fault identification and prognosis.
OSW	Durham University	Determination of Wind Turbine Enriched Health History for Condition-Based Maintenance and Troubleshooting	Y	Development of Engineering guided data mining algorithms for Wind Turbine fault identification and prognosis.
OSW	NAOME	Investigating structural behavior of wind turbine composite blade using FSI method	To be confirmed	To be confirmed
OSW	NAOME	Hydrodynamic analysis of land maneuvering operation of crew transfer vessel to floating wind turbine platform	To be confirmed	To be confirmed
OSW	NAOME	Control of floating wind turbines based on machine learning algorithm	To be confirmed	To be confirmed
Environment	University of Aberdeen	Sustainable Marine Ecosystems and Offshore Energy: A Bayesian modelling approach.	N	The aim of this PhD project is to develop a Bayesian ecosystem modelling approach to Cumulative Effects Assessment (CEA) for marine systems.
Environment	University of Aberdeen	Modelling primary production in Scottish waters and the impact of large scale marine renewables and climate change	N	This project will investigate the impact of large scale offshore wind on local and far-field hydrography and primary production. The outcomes will be placed in the context of future climate, comparing impacts of large scale MRE developments to climate change effects in 2050. Potential variations in deployment will be explored, assessing the importance of site selection, device position and array design.
OSW	University of Edinburgh	Performance enhancement of the WaveTrain WEC through numerical optimisation	To be confirmed	The main aim of the project is to gain an in-depth understanding of how the device interacts hydrodynamically with the waves and with itself. With this fundamental understanding, the current non-optimal design of the power modules can be

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				enhanced to improve power capture and/or reduce loads in the struts etc. Subsequently, the aim is to investigate the feasibility of changing the WEC geometry and other key parameters to optimise the power capture bandwidth. Development of the current array numerical model, again building up from that of the single isolated power module through the unlocking of certain locked degrees of freedom, the addition of sloshing in the water columns and the incorporation of various nonlinear hydrodynamic forces like the nonlinear Froude-Krylov forces. The accuracy of these improvements could be validated against the extensive existing experimental data. Use of the resulting validated numerical code within an optimisation tool to find the best design (geometry, configuration and control) of the power modules to optimise the power capture of, and/or load reduction within, the WaveTrain device. Further aims include optimisation of the applied load and control characteristics using the pneumatic turbine PTO system to maximise mean annual power absorption. There is a prospect of some additional tank test time to demonstrate experimentally the productivity enhancements developed through the numerical optimisation process.
OSW	University of Edinburgh	Morphing blades for enhanced fatigue life and performances of wind and tidal turbines	To be confirmed	The blades of axial-flow horizontal axis tidal and wind turbines experience continuous flow fluctuations. For tidal turbines this fluctuations are particularly large due to high turbulent kinetic energy in the tidal stream and of the wave-induced currents. This results in thick and expensive structures with short fatigue life, which are key issues for the wind and tidal energy sectors. The aim of this PhD project is to develop an intelligent blade that will cancel fatigue loads through a high-frequency shape morphing thanks to a new material made of electroactive polymers. This will prevent fatigue failures of the blades, and fatigue loads transmitted from the blade to the turbine. The resulting blades and turbine will be lighter and less expensive, ultimately decreasing the levelised cost of energy. The project will develop from acquiring the underpinning fluid mechanics knowledge, it will be based on a range of CFD simulations that will lead to performing proof of concepts experiments to demonstrate the potentials of the proposed technology. Simulations will be performed with OpenFOAM and a Large Eddy Simulation (LES) turbulence model,

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				whereas the proof of concept experiments will be performed on a model-scale tidal turbine in FloWave, the world's most sophisticated facility for testing tidal turbines.
OSW	University of Edinburgh	Application of Wide-Bang Gap power semiconductors in wind energy power converters	To be confirmed	Over the next 10 years it is possible that SiC technology will have mature to a level that power module costs become viable for bulk power applications such as wind turbines. The availability of these devices will allow greater flexibility in converter designs with the possibility of topologies that exploit faster switching speeds, lower conduction loss and increased connection voltage. These gains are not without technical challenges. Issues with high dv/dt, voltage overshoot and EMI will have to be addressed if increased switching speeds are to be exploited with currents in the range 1000-2000A. Such currents will require mass paralleling of MOSFET die/modules, which will be challenging for circuit layout, gate drives and module design. High dv/dt switching leads to parasitic oscillations will give rise to EMI issues affecting both internal systems and external EMC compliance. This same switching transient will be appearing at converter terminals and across module isolation barriers where it will impose additional stress on insulation materials.
OSW	University of Edinburgh	Multi-stage integrated magnetic gear generator system for renewable energy converters	To be confirmed	Magnetic gearing systems are being investigated for renewable energy converters as a replacement for mechanical gearboxes. Unlike a mechanical gearbox, there is no contact between the rotating parts between the low and high speed shafts, which given the reliability issues with conventional gearboxes is a major advantage of magnetic gear technology. An existing CDT student, Ben McGilton, has designed and built a rotary magnetic gear for testing in FloWave. The project will build upon the current PhD using the design tools developed, and will extend these to include multi-stage systems, and novel generator integration concepts. This mostly will focus on investigating the possibility of having a variable gear ratio and the opportunities and problems with may present.
OSW	University of Edinburgh	Carbon reduction potential of wind and marine energy systems and their interactions	To be confirmed	Information on life-cycle carbon emissions can inform decisions on whether to invest in or provide policy support for different types of renewable technologies. Existing assessments of the life-cycle carbon of marine and far-offshore wind (such as floating wind) suggest that emissions are significantly higher than for more mature technologies, such as onshore wind, causing some to question whether investment in

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				these new technologies is justified [1, 2, 3]. Life cycle assessments of embodied carbon, however, don't take into account the benefits that such technologies can provide in being available at different times to their competitors. The benefits of having a diverse supply mix are clear when considering a holistic view of the electricity system, and there is, therefore, a need to reflect such benefits in assessing the life cycle impacts. The challenge arises from existing life-cycle carbon estimates for renewable energy systems being focussed on emissions arising from the construction, maintenance and decommissioning of the generators themselves. The impacts are typically normalised per unit of energy produced and then compared with the impacts of other technologies, such as fossil generation or the average emissions of the grid, to demonstrate the likely carbon reduction potential. This comparison may be in the form of calculating the carbon payback time. This step makes an assumption about the types of existing generation that the new technology will displace; however, studies of the carbon emissions reduction of wind power have shown that such an assumption is a significant approximation [4, 5]. In reality, the displaced generation mix changes across days, seasons and years. Aims and Objectives The key aim of this project is to examine the environmental benefits of diversity in renewable energy resource and understand whether these justify greater investment in marine and far-offshore wind. This will include: *Provide an overview of the life cycle carbon (and other environmental impacts) of a broad range of wind & marine systems *Develop a methodology to account for the carbon reduction potential of different interacting technologies *Identify the carbon reduction potential of far-offshore wind and marine operating on the British grid. *Investigate the interactions between temporal fluctuations in renewable resource and how these combine with technologies such as storage to meet demand with maximum possible carbon reduction.

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				*Provide tools and guidelines for considering the holistic consequential impact on carbon emissions of wind & marine energy systems.
OSW	University of Edinburgh	Floating Tidal – Investigations of Optimal Floater Design with Respect to Hydrodynamic Responses and Turbine Loads	To be confirmed	This PhD project will look to assess how the design of floating platforms for tidal turbines can influence dynamic behaviour, responses to wave and currents and interactions with an operating tidal turbine mounted beneath the platform. The focus of the work initially will be, on the investigation of current floater designs, to classify and parameterize. Amongst the investigated topics will be mooring lines and required strengths, platform stabilities in a range of seas-states (including extreme weather events in which survivability becomes a main design criteria) and trade-offs between materials required (as a proxy for costs) and platform stability/longevity. Having classified the floaters, the next stage will be to model turbine dynamics and performance based on the investigation topics above. The modelling techniques at this stage are open to refinement and some different avenues will be explored, however the preferred approach currently is to develop a fully coupled CFD tool. Throughout this portion of the work the performance of the turbine and loading for its components will be considered, again in order to assess how platform choice may affect reliability and component lifetimes, but also to consider how operational dynamics such as turbine control are affected by the added dynamics present in the floating context. The final stages of the project will consist of a full system optimisation to determine potential optimal floating tidal designs by considering LCOE and accounting for both CAPEX and OPEX contributions, where reliability will be assessed on the basis of increased or decreased lifetimes for floating tidal based on the results of earlier stages of this project. Additional impacts of floating tidal will be considered in terms of their contributions here, such as reduced costs associated with device retrieval and increased access availability due to no longer needing heavy duty cranes for device removal. This would culminate in a novel/optimal design being proposed/recommended. This proposed design could then be tested in simulation or potentially using a physical scaled device in the test tank.

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OSW	University of Edinburgh	Bio-inspired unsteady load control to enhance power output and fatigue life of wind and tidal turbines	To be confirmed	This project aims to develop a new blade concept for wind and tidal turbines using porous blades to passively mitigate unsteady loads. It builds on nature-inspired research on the advantages of porosity and flexibility for passive flight control. Unsteady fluid loads on wind and tidal turbines cause fatigue and power fluctuations, increasing the levelised cost of energy (LCOE). Previous work on passive morphing blades shows that they can completely mitigate load fluctuations. However, for resilience and reliable blade, flexibility may be restricted to the trailing edge, limiting mitigation efficacy. To gain additional load mitigation, the trailing edge can be porous, with its porosity controlled passively and in tandem with its deformation. Staggered holes in the top and bottom surfaces of the trailing edge may be brought into alignment as the trailing edge is deflected by increased fluid load. This low inertia, passively controlled trailing edge could react to high frequency fluctuations thereby combining the efficacy of active, low interia control surfaces with the reduced maintenance of passive control. Additionally, unlike existing passive control methods that rely on structural couplings, the trailing edge could be tailored along the full blade span, mitigating unsteady loads down to the root to reduce flow separation and energy losses and create a cleaner wake for downstream turbines - critical for large, compacted farms. This project capitalises on the recently concluded Leverhulme Trust (RPG-2015-255) project on the flight of the dandelion fruit, which demonstrated how the vortical flow structures and the forces on a porous surface can be controlled by porosity, making it possible to stabilise the wake behind a flow immersed body to generate new flow structures that would otherwise be too unstable to exist. This is, in fact, the mechanisms exploited by the dandelion fruit to fly, unpowered for hundreds of kilometres. We hypothesise that a similar principle is also exploited by birds, whose wings are both flexible and porous, to mitigate the effect of gusts. World-leading research groups, such as Spedding at UCLA, are currently investigating the aerodynamics of porous wings for aeronautical applications. This project will combine

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				recent findings on the effects of porosity and flexible blades to develop a new blade concept for wind and tidal turbines.
OSW	University of Edinburgh	Investigation of the causes for wind turbine underperformance and increased failure rates	To be confirmed	Offshore wind power is expected to make up an increasingly significant proportion of the energy mix in future years within the UK. This presents logistical challenges to wind farm operators in the form of bigger wind farms, further offshore, meaning that operations & maintenance costs and turbine reliability are becoming increasingly significant. Data pertaining to this issue can be roughly categorised into four groups: condition monitoring data, operational data, vessel & weather data and turbine properties (e.g. position in the array). The aim of this PhD is to investigate the inter-dependence of factors that fit into these categories, and how these relationships effect wind farm availability and costs. The outcomes of this investigation will lead to suggestions for better O&M practices for offshore wind farms
OSW	University of Edinburgh	Properties and Performance of marine Composite Materials in the Splash Zone	To be confirmed	Composite marine structures receive cyclic exposure to the marine environment. In one state they are exposed to water pressure, and wave slap loading, in another, the composite surfaces are wetted, dried out and then wetted again. These can be exposed to a variety of temperatures, marine growth, salinity levels, and ultraviolet radiation exposure. These environments and changes in environment require composite marine structures to have sufficient design margins and factors applied as knowledge is limited. By conducting innovative research in this environment niche, more standardised methods rules and applications of composites can be developed. Research shall be conducted from predominantly laboratory based work. This will involve composite coupon testing, accelerated aging and full scale composite structure testing. If this timeline aligns, this will coincide with the use of University of Edinburgh's FASTBLADE facility.
OSW	University of Hull	From textile waste to advanced carbon materials for wind turbine blade manufacturing	N	Utilisation of textile waste as a raw material for nano-carbon filaments production and their consequent application as a filler for CRC.
OSW	University of Hull	Novel Acoustic Methods for Directly Monitoring Seabed Sediment Transport, Geohazards & Scour	N	Develop and field test novel acoustic methods for directly monitoring and understanding processes of seafloor sediment transport and scour

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OSW	University of Hull	The impacts of windfarm associated noise on commercially important invertebrates	N	Understand the impact that industrial noise (seabed vibrations) from construction, operation, and decommissioning of wind turbines has on seabed invertebrates such as lobsters and mussels.
OSW	University of Hull	Wind to Hydrogen and ePTA: Chemical Manufacture through Electrolysis	N	Determine the technical, environmental and economic feasibility of producing hydrogen *via* water electrolysis, with co-generation of both oxygen and purified terephthalic acid (ePTA) used to produce the recyclable plastic PET (polyethyleneterephthalate).
OSW	University of Hull	Impacts of Seabed Vibration on Sediment Structure and Infaunal Organisms	N	Understand the direct and indirect effects of seabed vibration on the behaviour, physiology (as short term, immediate responses) and growth (impacting on long-term fitness) of infaunal organisms
OSW	University of Hull	Incorporation of Energy storage into offshore wind farms for load levelling and energy security	N	Examine the use of different energy storage technologies in offshore wind farms to provide a more continuous power flow from the farm to the grid.
OSW	University of Hull	Distributed sensing of blade loading for structural health monitoring	N	To evaluate the capability of distributed fibre optic and other sensors for monitoring blade loading during operation and it identify and locate damage
OSW	University of Hull	Assessing and developing methods to measure the economic impact of major investments on local economies: The case of Siemens' and ABP's Investment in The Humber Region.	N	To develop methods to assess the economic impact of major infrastructure investments on regional economies. The case study is the Greenport Hull investment by Siemens and Associated British Ports in wind turbine manufacture and load out facilities
OSW	University of Hull	Development of composite coating materials for wind turbine blade erosion control.	N	To assess the performance of graphene based materials for impact dissipating coatings for wind turbine blades
OSW	University of Hull	DREAM: Data-driven Reliability-centred Evolutionary Asset Manager	Y	Develop tools to assist in operation monitoring and maintenance planning. Using statistical models of fault sequences to identify recommended maintenance actions
OSW	University of Hull	Offshore Wind Turbine Maintenance: Building a spare parts demand forecast to optimize Inventory Management System	N	The objective of this research is to build a forecast system to estimate demand of the spare parts required for maintenance, based on different fault prediction data. The forecast system will use a combination of historical data analysis
OSW	University of Hull	Autonomous Prediction and Scheduling of O&M for Offshore Wind Farms	N	To perform causal inference with wind turbine SCADA data, and use this for implementing a knowledge base towards generating messages for turbine faults

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OSW	University of Hull	Effect of wind-wave interaction on the physiological behaviour of offshore wind technicians	N	The threee onjectoves are 1: Identify the presence of wave-current interactions in test sites. 2: Model the relationship between wave-current interactions and sea-sickness based personnel state through vessel motions. 3: Explore the impact of personnel state model on operation and maintenance scheduling.
OSW	University of Hull	Wind turbine load mitigation through individual Pitch Control	N	To evaluate individual pitch control methods to mitigate tower loading and develop fault estimation techniques to ensure robustness of performance in the presence of pitch sensor and actuator faults
OSW	University of Hull	Fatigue in OSW technicians	N	To understand the sources and consequences of fatigue in the working context of O&M technicians.
OSW	University of Hull	Safety Climate in OSW	N	To explore the threats to technician safety and develop a bespoke psychometric safety climate assessment tool.
OSW	University of Oxford	Progressive Distortion of Offshore Wind Turbine Monopile Foundations During Installation	To be confirmed	To be confirmed
OSW	University of Oxford	Medium Scale Field Testing of Monopile Foundations Under Cyclic Lateral Loading	To be confirmed	To be confirmed
OSW	University of Oxford	Advanced element testing of soils under complex cyclic loads	To be confirmed	To be confirmed
OSW	University of Oxford	Theoretical Developments for Soil Behaviour Under Cyclic Loading	To be confirmed	To be confirmed
OSW	University of Oxford	Identification of Offshore Wind Turbine Foundation Properties from Monitoring Data	To be confirmed	To be confirmed
OSW	University of Oxford	Rate Effects for Monopile Foundations	To be confirmed	To be confirmed
OSW	University of Oxford	Calibration of Cyclic Loading Models for Monopile	To be confirmed	To be confirmed
OSW	University of Oxford	A Laboratory Investigation into the Behaviour of Sand at Low Stresses	To be confirmed	To be confirmed
OSW	University of Oxford	Scour and Scour Protection Effects: Monopile Flume Experiments	To be confirmed	To be confirmed

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OSW	University of Oxford	Response of a Monopile to Complex Cyclic Lateral Loading in Dry Sand	To be confirmed	To be confirmed
OSW	University of Oxford	Axial Response of Offshore Jacket Piles Supporting Wind Turbines	To be confirmed	To be confirmed
OSW	University of Oxford	Development, Implementation and Assessment of Constitutive Models for Finite Element Analysis of Offshore Foundations	To be confirmed	To be confirmed
OSW	University of Oxford	Numerical Modelling of Laterally Loaded Monopiles	To be confirmed	To be confirmed
OSW	University of Oxford	Wind turbine wake modelling	Y - partial	The overall objective of this programme of work is to develop new engineering models for wind farm modelling that will enable higher accuracy engineering modelling of wind farm flows, turbine and wake interactions, energy yield and turbine loading, leading to improved deployment and control strategies that will result in reduced LCoE.
OSW	University of Oxford	Wind turbine wake analysis and modelling	Y - partial	To be confirmed
OSW	University of Oxford	Wind turbine interaction modelling within the atmospheric boundary layer	N	Modelling and development of new analytic models for the interaction of large wind farms with atmospheric boundary layers.
OSW	University of Oxford	Wind turbine interaction modelling within the atmospheric boundary layer	Y - partial	To be confirmed
OSW	University of Oxford	Wind turbine peformance degradation due to blade surface damage	N/A	Rotor scale computational modelling of performance degradation due to wind turbine blade damage. Controller driven reoptimization of damaged rotors. Whole farm lifetime performance changes and degradation analysis.
OSW	University of Oxford	Complex 3D rotor blade flows	N/A	Simulation and analysis of complex 3D blade flows leading to new anisotropic wind and tidal turbine blade load correction models.
OSW	University of Oxford	Multi-scale renewable energy flow problems	N/A	Analytic modelling and 3D CFD of complex multi-scale flow problems effecting the performance of single and multiple turbines.
OSW	University of Oxford	Cyclic loading of monopile foundations	To be confirmed	Investigation of the behaviour of monopile foundations by focusing on finite element modelling and developing the work from PISA Project, applying new scenarios as well as exploring the application of machine learning approaches to offshore geotechnical design.

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OSW	University of Oxford	Wind turbine wake analysis and modelling	To be confirmed	High fidelity Computational Fluid Dynamics (CFD) will be used to simulate flows past individual and small clusters of wind turbines to develop detailed models of wind turbine wakes and their merger and interactions. The performance and wakes of generic large turbines will be considered. The influence of vertical flow shearing, cross-stream variation in speed and turbulence intensity, and relative device placement that lead to inviscid (blockage) and viscous interactional effects will be considered. CFD simulations will be performed with blade resolved RANS models and Actuator Line LES models in order to capture relevant wake physics. Simplified representation and reconstruction of turbine wakes is of critical importance to developing understanding of the physical processes governing wake evolution. Flow-field decon-struction methods such as POD (Proper Orthogonal Decomposition) will be used to identify the leading order wake modes and physical processes important in wake development, merger and representation, which will be used to devel-op new wake merger and evolution models and algorithms.
OSW	University of Oxford	Simulation and stability of complex three-dimensional flow problems	To be confirmed	High accuracy computational fluid dynamics modelling, together with stability and sensitivity analysis, are key tools in developing deeper and fundamental understanding of complex three-dimensional fluid mechanics problems. The research focus will be on using these techniques to study problems of relevance in the fields of renewable energy and flow-induced vibration. Key problems that will be addressed include three-dimensional wind turbine blade tip flows, including how these flows relate to span-wise flow effects and how tip flows can ultimately be controlled, stability of helical vortex structures in the wakes of wind turbines, and how their break-down can be controlled and modified, and the validity of the independence principle in yawed flow problems including stationary and vibrating cylinder problems.
OSW	University of Oxford	Computational Modelling of Large Scale Wind Farms	To be confirmed	The objective of the project is to reduce the cost of future large wind farms through the development of new wind farm flow interaction models. Engineering models are used to optimise the layout of wind farms, estimate loads on wind turbines, and investigate farm-wide control strategies. Current models, that were developed for smaller wind farms and less significant turbine inter-actions, are reliant on empirical turbine representations and overly simplified wake

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				interaction models, that have been shown to be prone to error in even simple turbine interactional cases. Errors in such models can have a large impact on the Levelised Cost of Energy of a wind farm. Working with the E.ON renewables team the project will seek to develop a new type of wind turbine interaction model that is based on more complex flow interaction physics that will be simulated through blade resolved and reduced order CFD methods. The improved interactional physics will be used to build a new Lagrangian transport wind farm interaction model.
OSW	University of Oxford		To be confirmed	To be confirmed
Tidal	University of Oxford	Hydroelastic blade design for tidal rotors	N	Analysis and design of hydroelastic blades. Changes to performance due to blade loading and control of rotors using mixed speed and deformation control.
Tidal	University of Oxford	Load control of arrays of turbines	N	Use of fluid mechanical control mechanisms to control the loading distribution across arrays of turbines, including the use of yaw control in closely-spaced tidal turbine arrays.
Tidal	University of Oxford	Unsteady loading of tidal turbines in oscillatory motions	N	CFD simulation of tidal turbines undergoing surge, heave and pitch oscillations as might be experienced by turbines suspended from floating platforms.
Tidal	University of Oxford	Unsteady loading of tidal turbines	N	Simulation and experimental testing of tidal rotors experiencing unsteady loading due to free stream turbulenece and waves.
OSW	University of Plymouth	Probabilistic Design in Offshore Renewable Energy	N	The core aim of this research is to develop and apply probabilistic design methodology in the context of offshore renewable energy (ORE), with a particular emphasis on floating platforms.
OSW	University of Plymouth	Assessment of Design Loads for Floating Offshore Wind Turbines	N	The focus of this research is to investigate design approaches for FOWT in the hurricane prone region of Jamaica.
OSW	University of Plymouth	Laboratory Wind generation and Measurement in a wind-wave facility	N	The goals of the project are to design and develop a new wind generation facility for the COAST Laboratory and to study combined loads of wind and waves on floating offshore wind turbines.
OSW	University of Sheffield	Multiphysics investigation of direct-drive permanent magnet wind power generators	Y	To investigate the mechanical modelling and vibration prediction of permanent magnet (PM) synchronous generators for direct-drive wind power applications.
OSW	University of Sheffield	Sensorless control of wind power permanent magnet generators	y	To investigate the sensorless control strategies of wind power generators under operation tolerances

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PhD projects in Offshore Renewable Energy

Information provided correct as of June 2020

Sector	University (A-Z)	Title of PhD thesis	Financial support from industrial sponsor? (Y/N)	Description & key aims
OSW	University of Sheffield	Sensorless control of wind power permanent magnet generators	y	To investigate the sensorless control strategies of wind power generators under fault conditions and manufacture tolerances
OSW	University of Sheffield	Novel wind power generator systems	y	To develop novel wind power generators with high power density for direct drive wind turbine
OSW	University of Sheffield	Investigation on Novel PM Machines for Wind Power Application	Y	Develop novel permanent magnet generators that have high torque/power density, low cost and high reliablity for offshore wind application
OSW	University of Sheffield	Fault modelling and diagnostics of PM machines for wind power application	Y	This thesis will first look at the modelling and diagnostics of different types of faults (particularly electric faults such as phase open-circuit, short-circuit including inter-turn short-circuit) and their influence on machine electromagnetic, thermal and mechanical performances.
OSW	University of Sheffield	Design and thermal management of novel modular permanet magnet machines	Y	This project investigates the possibility of using modular stator structure for improved internal cooling inside a modular permanent magnet generator. Extensive electromagnetic and also computational fluid dynamic simulations will be carried out for accurate performance predictions.
OSW	University of Sheffield	High frequency effects in inverter-fed electrical machines	Y	To be confirmed
OSW	University of Sheffield	Control of multi-three-phase PM wind power generators with different phase shifts and asymmetries	Y	To be confirmed
OSW	University of Sheffield	Comparative study of mega-watt wind power converters with an emphasis to direct AC-AC multilevel power conversion	Y	To be confirmed
OSW	University of Sheffield	Power Electronic Conversion Systems for Wind Power	Y	To be confirmed
OSW	University of Sheffield (Mech Eng)	Rolling Bearing Sensor Systems	Y	Load, stress, and lubrication measurement for rolling bearing life estimation. 1. Define method for contact stress-based life estimation. 2. Stress-based life estimation of demonstration case - simulation approach. 3. Actual contact stress measurement campaign of demonstration case.
OSW	University of Sheffield (Mech Eng)	Damage and Failure in Wind Turbine Pitch Bearings	Y	Identification of influential parameters and sensitivity study on false brinelling and fretting corrosion failure for wind turbine pitch bearings. 1. Literature review and analysis of pitch bearing failure mechanisms due to false brinelling and fretting

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PhD projects in Offshore Renewable Energy

Information provided correct as of June 2020

Supergen Offshore Renewable Energy

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				corrosion; and pitch bearing load numerical modelling. 2. Development of a Finite Element model of the pitch bearing assembly to investigate bearing load and contact pressure distributions. 3. Relate bearing loading to published work on failures due to fretting and brinelling.
OSW	University of Strathclyde	Analysis and Design Metholody for Development of Novel Floating Support Platform for Wind Turbines	To be confirmed	To be confirmed
OSW	University of Strathclyde	Optimal welding processes for life cycle performance of marine structures	To be confirmed	To be confirmed
OSW	University of Strathclyde	A Surrogate Model Framework for Structural Lifetime Extension Assessment of Wind Turbines	To be confirmed	To be confirmed
OSW	University of Strathclyde	The development of a coupled model of dynamics of a FOWT for the analysis of the failure modes	To be confirmed	To be confirmed
OSW	University of Strathclyde	Development of multi-disciplinary prognostic and diagnostic model of dynamics for the O&M of an offshore bottom fixed wind farm	To be confirmed	To be confirmed
OSW	University of Strathclyde	Development fo Risk Policy for Offshore Wind Energy Industry	To be confirmed	To be confirmed
OSW	University of Strathclyde	Machine learning Technigues applied to Future wind turbines.	To be confirmed	To be confirmed
OSW	University of Strathclyde	Optimising and Closing the design loop of Offshore Wind Farm and assets useful life using measured (monitoring) data.	To be confirmed	To be confirmed
OSW	University of Strathclyde	Reliable O&M decision tools and strategies for high LCoe reduction on Offshore Wind	To be confirmed	To be confirmed

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OSW	University of Strathclyde	Reliablility-based Optimisation of Floating Wind Turbines Support Structures	To be confirmed	To be confirmed
OSW	University of Strathclyde	Extrapolation of Offshore Wind turbine SHM data from instrumented to non instrumented units	To be confirmed	To be confirmed
OSW	University of Strathclyde	Advanced numerical methods for optimisation of next wind turbine support structures	To be confirmed	To be confirmed
OSW	University of Strathclyde	Corrosion of welded joints in offshore wind turbine foundations	To be confirmed	To be confirmed
OSW	University of Strathclyde	Experimental assessment of unsteady rotor loads and aerodynamic modelling with a view to application to floating wind turbines	To be confirmed	The current expansion of offshore wind generation capacity is limited by the depth of water and sea bed conditions present within a defined development area. One solution to negate the constraints to the growth of offshore installed capacity would be the development of floating wind turbine systems. There are many challenges restraining the development of this system, not least of which the aerodynamic response of the turbine given the coupled aerodynamic and hydrodynamic actions. This work aims to quantify the unsteady rotor loading as a result of the coupled dynamic behaviour by experimental assessment. This will require the design and construction of suitable apparatus to replicate, at scale, the dynamic response of the floating wind turbine system. Following this, appropriate data analysis tools will have to be developed in order to identify the rotor loading response as a result of the coupled aerodynamic and hydrodynamic behaviour.
OSW	University of Strathclyde	Detailed dynamic modelling of wind turbine drivetrains	To be confirmed	Drivetrains have been singled out as one of the largest causes of wind turbine downtime and it is anticipated that in an offshore environment, this is likely to remain the case. The majority of gearbox failures arise in the bearings, predominantly the high speed shaft and generator bearings. One cause of this is believed to be shaft misalignment, resulting in excessive loads to be applied to these bearings. Analysis into the root cause of these misalignments has been based on pseudo-steady loading. This PhD will look to investigate the effects on the drive train due to loading imposed

PhD projects in Offshore Renewable Energy

Information provided correct as of June 2020

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				by the electrical generator through the simulation of electrical faults and eccentric motion of the generator rotor. Focus will also be directed towards transient loading on the drivetrain and the discretisation of the models produced. A dynamic model of the drivetrain is to be developed to analyse these scenarios. The use of converter control in a bid to mitigate loading on the grid side of the drivetrain will also be investigated. The PhD is to be carried out in collaboration with Romax Technology who will be providing their in-house modelling software, RomaxWind.
OSW	University of Strathclyde	Vertical Axis Wind Turbine Drivetrains	To be confirmed	This three year project looks to evaluate the potential of Vertical Axis Wind Turbines (VAWTs) for offshore wind generation at a commercial scale. This involves investigating the potential drivetrain options for VAWTs to determine the benefits and drawbacks associated with these options in terms of cost, efficiency and availability. The aim is to find the configuration that produces the lowest Cost of Energy possible and comparing that to equivalent multi-MW horizontal axis wind turbines currently on the market.
OSW	University of Strathclyde	Control System Design of a Multi Rotor System	To be confirmed	Multi rotor systems (MRS) are considered a promising concept for the design for large scale wind turbines. The University of Strathclyde (UoS) have contributed to the InnWind report exploring different options for 20MW turbines. Following on from work on the design of such systems my research is focused on the control of an MRS whilst also looking at aspects of the electrical system design. The work is closely related to the UoS's work on integrated wind farm control where, without interference to the turbine local control algorithms, control system response may be modified by accessing control system input signals. This would enable interesting control strategies such as control of system overturning moment through height of the thrust centre and yawing the machine by adjusting the thrust across the array.
OSW	University of Strathclyde	Spatio-Temporal Prediction of Wind Based on Wind Velocity and Related Parameters	To be confirmed	This project involves spatio-temporal predictions of wind speed and direction by means of linear complex valued prediction filters. The aim will be to investigate several aspects of the algorithm in order to accurately predict the wind speed. Suitable data will be explored and several applications could be investigated. A first and important application is to accurately predict the wind speed at a number of wind farm sites a few hours ahead, for this purpose data from a real wind farm might be

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				available. As a second application, a low-power renewable-energy communications base station network on the Western Isles of Scotland could be explored.
OSW	University of Strathclyde	Impact of Marine Dynamics on Offshore Wind Farm Access	To be confirmed	There is significant potential for costs reductions by improving access logistics for offshore wind. Operation and maintenance has been "estimated at 30%" of lifetime costs with new offshore wind farms being further from shore access is becoming an ever more important consideration. Weather conditions are a key factor in offshore wind access logistic. The planned project will look at how improvements in modelling of wind speeds, wave heights and marine currents can improve offshore wind farm access logistics. There is a strong drive to reduce the costs of offshore wind energy. Access to offshore wind is a significant factor in costings. Two of the main costs are vessel costs and lost earnings, which are both significantly affected by weather conditions. Waiting for weather windows to utilise specialised vessels for offshore installation and maintenance adds significantly to costs, especially for short term hire vessels. The key objectives are to model the directional dependence of wind, wave and marine currents. Wind and wave time series will be analysed focusing on the directional characteristics, with the most appropriate model being selected for the study. Research into modelling marine currents will be conducted with a focus on improving knowledge of the processes that drives them and the impact on offshore wind farm accessibility. The models will be standardised for different offshore locations and data sources. Access models will be improved to minimise cost implications of vessel usage. The study will use linear regression analysis, time series modelling, technical and economic analysis. Other models such as models for vessel transits in variable weather conditions could be included. The limited available data can be assumed to be representative, as offshore wind site conditions and turbine sizes are relatively similar. More research is needed on the effects of wind and wave directionality, as well as on marine currents. Future work could analyse the data sources specified and find new data sources.
OSW	University of Strathclyde	Reliability Cost-Benefit of Meshed International Transmission Networks	To be confirmed	The development of point to point wind farm transmission connections to offshore projects is now being challenged as offshore wind farms are being developed further offshore and to larger scales. With the challenges of delivering offshore wind at lower projected costs, the benefits of coordinated, interconnected and multiuser offshore

PhD projects in Offshore Renewable Energy

Information provided correct as of June 2020

Supergen Offshore Renewable Energy

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				transmission systems are being investigated by the Governments, Transmission. The PhD aims to develop a methodology to robustly quantify the benefits of greater interconnectivity as described above, and compare with existing point to point model of connection. The output will be used to drive change in offshore connection agreements.
OSW	University of Strathclyde	New Control Systems for Aeroelastic Tailoring of Wind Turbines	To be confirmed	Wind turbine with aeroelastically tailored blade (ATB) has shown that it can benefits the cost of energy. ATB is studied to improve the turbine's annual energy production and also to alleviate structural loads simultaneously. Apart from materials and physical studies of the blade, control system plays an important role to achieve the aims and objectives of the research. This study is to develop a new control law that is able to minimise of the blade, rotor loads and the pitch activity and to analyse the performance of wind turbines with conventional blades and ATB.
OSW	University of Strathclyde	Reduction in direct drive generator cost through active control of the airga	To be confirmed	Maintaining uniform airgap in a large scale permanent magnet direct drive generator with minimum weight and cost is a challenge. Failure to achieve it can cause the physical contact of rotor and stator, which in turn lead to structural damage of the generator. The scope of directly controlling the field excitation to control the attraction force as necessary like in conventional field excited synchronous machine cannot be achieved in Permanent magnet machine due to permanent presence of the field. This requires the rotor and stator to have additional structural stiffness enough to resist the possible deformation due to attraction forces. However, the weight of generator can be issue in this case and can be even challenging as its size scales up. A possible use of the modular power electronic converters connected to multi-coil generator that can regulate the airgap closing force has been demonstrated in the literatures. This project is to present the possible solution to the problem related to closing of airgap in the large scale direct drive generator by developing suitable control strategy for modular power electronic convertors that can be connected to the groups of coils in multi-coil permanent generator to achieve airgap regulation.
OSW	University of Strathclyde	Improved yield from wind turbines through online anomaly detection and compensation	To be confirmed	The aim of the work is the development, implementation and assessment of various detection and compensation techniques to make best use of all the data that should be available to a wind turbine control system. The work should look to use measurements already collected on wind turbines or can be collected by standard

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				cheap means. The work will look to utilise advanced algorithms or data processing techniques to make better use of all the available data. The work will also seek to assess the actual benefits, performing a cost/benefit analysis of the solutions.
OSW	University of Strathclyde	A Market Assessment Methodology for Small Wind in the Developing World	To be confirmed	There is a clear correlation between energy access and human development. This project aims to determine which countries in the world are most in need of off-grid rural electrification projects, and which of these countries are most suited to the deployment of small wind turbines for off-grid generation in the context of poverty alleviation. The assessment will use Multi-Criteria Decision Making techniques in order to structure and weight competing factors appropriately. Ultimately the intention is to produce a list of countries recommended for small-wind projects, for use by Wind Empowerment and other relevant agencies.
OSW	University of Strathclyde	Application of Wind Farm Control and Wind Farm Layout for the Optimisation of Wind Farm Power and Loads	To be confirmed	For many years wind turbines have typically been operated as single entities, regardless of whether they are part of a larger wind farm or not, a strategy that often does not lead to the most optimum performance of the wind farm. Typically, the variable that operators would like to optimise is the cost of energy. One method of decreasing cost of energy is to maximise the power output of the wind farm. Given a series of turbines, each one in the wake of the next, the optimum solution for maximising the total power output is typically to reduce the power output of one or more upwind turbines. Another consideration is minimising the expense of maintenance, requiring an understanding of how winds affect the loadings on wind turbines, how the operational strategy of wind turbines can be altered to reduce loadings, and how the wind propagates through the wind farm. Hence, through design of the wind farm layout and active dynamic control of the wind turbine operational strategies, it is possible to bring about a more optimum farm output than the usual method of simply controlling each turbine in the farm individually.

PhD projects in Offshore Renewable Energy

Information provided correct as of June 2020

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OSW	University of Strathclyde	Localised electricity markets for distributed wind generation	To be confirmed	The focus of this PhD is the development of new business models for local electricity trading by matching local demand to local supply, and the evaluation of such models in terms of reducing or increasing costs and revenues for owners of distributed generators and other systems participants.
OSW	University of Strathclyde	Development of Safe and Efficient Operations for an Airborne Wind Energy System – A Rotary Kite Design	To be confirmed	This PhD project is to investigate the efficient and safe operation of a rotary airborne wind energy device in uncertain environments through control. This project will focus on the Daisy kite system as developed by Windswept and Interesting Ltd. Through the development of a mathematical model the understanding of the Daisy kites characteristics will be improved. The mathematical model is to be used to optimise the Daisy kite design for power capture and to develop its control systems with the aim of having a fully automated device.
OSW	University of Strathclyde	Physical Modelling of Wind Turbine Components for Condition Monitoring	To be confirmed	Physical modelling of wind turbine components will focus on the gearbox, to generate a greater understanding of failure and remaining useful life. Physical modelling will include thermal modelling, based on secondary data and design specifications from Vestas and ORE Cataput, and primary experimental data from the University test rig. The aim of the PhD is to create physical models of wind turbine components to be utilised for condition monitoring and failure prediction to help lower the LCOE from O&M.
OSW	University of Strathclyde	Failure and Remaining Useful Life Prediction of Wind Turbine Generators	To be confirmed	The PhD will involve creating a novel engineering support solution for predicting failure and the remaining useful life of wind turbine generators for both induction and permanent magnet machines. To do this SCADA data analysis, high frequency vibration data and advanced signal processing methods will be utilised to first diagnose key fault modes, before combining these techniques with learning algorithms for fault prognosis.
OSW	University of Strathclyde	Investigation and assessment of the benefits for power systems from wind farm control	To be confirmed	This project seeks to research methods of modelling the effect of grid integration on wind farms through the use of the University of Strathclyde's in house software Strathfarm. The work involved in this research will be: -Designing a power system model in Strathfarm which could be switched to for researching the effect of faults. -Using this model to research the provision of ancillary services including frequency

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				support at a wind farm level. -Investigating whether wind farm or wind turbine control can be utilised to improve fault ride through provision. -Studying the impact of all of this on the turbines, looking at aspects such as loads.
OSW	University of Strathclyde	Study of the Chemical Degradation of Wind Turbine Blade Coatings Due to Erosion	To be confirmed	Erosion of the leading edges of offshore wind turbine blades has been found to be a significant issue, both for the maintenance and repair costs associated with repairing blades via rope access on offshore wind turbines, and for the associated loss of power performance, leading to an increase in the cost of energy. Erosion occurs mainly due to the impact of rain and other particulates, and the degradation of erosion protection coatings due to weathering. The erosion conditions for offshore wind turbines is greatly increased compared to onshore due to the larger wind turbine blades operating at higher tip speeds, but also the higher wind speeds seen offshore, both conditions causing higher impact velocities from the impacting rain. These impacts cause high shear and compressive loads into the applied protection coating and blade structure via shock impact loads, first on the initial impact of the drop but also through secondary loading on collapse of the water droplet. It has been seen that current coatings don't have sufficient resistance to these higher offshore loads, leading to cracking, pitting and peeling of the coating, and exposure of the blade composite structure over time if damage is not repaired. The degradation mechanisms of the coatings due to the shock impact of rain droplets is not well understood. It is not known how the stresses build up in the coatings and whether they attack specific bond types, if there is an order to the attack, and which chemical bonds are most resistant to erosion. It is also not known what triggers the move from the incubation period, where no erosion occurs, to erosion damage. Understanding is also required of the strain rate loading and how it affects elastic coatings, and coatings with various degrees of viscoelasticity. In the field, erosion from rain droplet impact occurs concurrently with exposure to weathering from UV, humidity and temperature cycling. Offshore, salt may also be influencing coating degradation. Although the breakdown of coatings in weathering is

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				widely researched for individual coating types, how the weathering influences the rain droplet erosion process at a microscopic and molecular level is not. This is hampered significantly by the fact that in the laboratory, testing for both weathering and rain impact is accelerated but over different acceleration timescales. Therefore, standard practise is to pre-weather rain erosion specimens, and thus record the performance of a pre-degraded coating.
OSW	University of Strathclyde	Influence of complex flow from atmospheric and forestry on the load accumulation of large wind turbines	To be confirmed	Predicting loads and moments on wind turbine components using aeroelastic modelling tools and the subsequent assessment of fatigue damage is vital to competitive design of wind energy projects. Offshore wind turbines are rapidly increasing in size as the industry matures; with rotor diameters over 200m and tip heights above the atmospheric boundary layer in some atmospheric conditions which can result in significant wind shear, turbulence and the experiencing of low level jets. Similar trends are true for onshore wind turbines resulting in increased shear and turbulence effects occurring from forestry and terrain. This research will develop an aeroelastic and damage accumulation model for the anticipated next generation of offshore and onshore wind turbines. Through modelling and measurement an understanding of the complex wind conditions experienced by these turbines will be sought. These complex wind profiles will then be applied to the aeroelastic model and their influence on damage accumulation assessed. Finally load mitigation will be investigated to ensure designed turbine life is met despite the complex wind conditions, minimising LCOE and maximising energy production.
OSW	University of Strathclyde	Variable Frequency Transformer (VFT)-based Integration of Low Frequency Alternating Current Offshore Wind Power	To be confirmed	Low frequency alternating current (LFAC) power transmission has been recently proposed for transporting the energy generated by a distant offshore wind farm to the main AC grid. The advantages of LFAC are the increases in power capacity and transmission distance for a given submarine cable compared to 50Hz or 60Hz HVAC. Nevertheless, at one point it is required to transform the LFAC current provided by the offshore wind farm to the standard 50Hz or 60Hz frequency of the main AC grid. VFT's can enable this bidirectional power flow between two different frequency networks without the need of costly power electronic systems.

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OSW	University of Strathclyde	Development of the next generation of wind turbine controllers	To be confirmed	As wind turbine size increases, the demands on the controller to reduce loads and improve performance are increasing. One way in which to improve controller design is to modify the control strategy by increasing the number of inputs regarding operating conditions and states. These inputs, provided by effective wind field models, anomaly detectors and wind speed and aerodynamic estimators, will allow specific control strategies to be selected. This project will use these inputs to select new control strategies will meet the controller objectives ,while increasing predictability, and will allow the controller to adapt to different circumstances effectively. Controllers will then be designed to meet these strategies and will be implemented and tested using Simulink and Bladed.
OSW	University of Strathclyde	Analysis of cumulative impacts of offshore windfarms using environmental impact assessment and post-construction data	To be confirmed	The continual growth of more, larger wind farms offshore introduced by The Crown Estate's Round 3 seabed leases will lead to a substantial area of sea used for generating renewable energy. With this growth of offshore wind farms in UK coastal waters, the cumulative impact of nearby wind farms has become an increasing concern for regulatory authorities and statutory consultees alike. The assessment, or lack, of such collective impacts have previously led to delays in granting consent, which can have implications for the start of construction and operation. Environmental data is regularly collected at offshore wind farms as part of Environmental Impact Assessments, Environmental/Ecological Monitoring Plans, and Crown Estate data availability requirements. However, the interaction of impacts and cumulative impacts of nearby wind farms are rarely investigated. There is a wealth of publicly available data from individual windfarms which is not analysed as a whole. Such investigation may yield useful information regarding cumulative impacts. This could help optimise the location of future wind farms to reduce negative impacts and increase benefits. The cumulative impacts of existing windfarms can then be taken into consideration during the planning, construction, operation, and monitoring of upcoming windfarms. Key components of Cumulative Impact Assessments are Valued Ecosystem Components (VECs). These highlight significant aspects of the environment that should be considered when analysing the impact of a project. The VECs identified through existing offshore windfarm impact assessments will be investigated through

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				this research, which may also bring to light other VECs which have not otherwise been considered.
OSW	University of Strathclyde	Error assessment of acoustic velocimeters for large-scale non-obtrusive 3-D velocity sensing applications	To be confirmed	Tidal turbines are subject to complex flow conditions, influencing power conversion rate, blade fatigue loading, reliability and O&M. Capturing the flow area of interest for tidal turbines applications, i.e. in front of the rotor plane, is complex due to its mid-water depth location, and its highly energetic and turbulent characteristics. The research of this PhD focuses on assessing the error and uncertainty of a novel flow measurement instrument that has the potential to increase the spatio-temporal resolution at which remote field measurements can be made in the energetic flow environments. This instrument consists of multiple spatially-separated single beam acoustic Doppler profilers converging on a remote focal point. Experimental study of the sources of measurement error and uncertainty associated with this instrument is carried out in a controlled laboratory environment. Velocity measurements from the studied cases are statistically compared against measurements from a reference laboratory velocimetry instrument. Findings will provide confidence in measurements from converging configurations of acoustic Doppler profilers of customisable form (e.g. geometry, size and sensor number) parametrised for tidal turbines applications.
OSW	University of Strathclyde	Machine Learning in Wind Turbine O&M	To be confirmed	Wind Turbine operations and maintenance makes up a significant part of the cost of energy, and the aim is now to try reduce that. Condition based maintenance has now become favoured to increase the availability and reduce the uncertainty related to Wind Turbine failures. Condition monitoring is needed, and this involves collecting and analysing data from many sources on the turbine, which can then be used to schedule maintenance when the turbine needs it. The ideal next step is to then be able predict a failure. Ideally machine learning can achieve this, as it can utilise supervised learning to discover the different characteristics between a healthy and unhealthy signal. This PhD aims to look at this concept for various different work packages relating to Wind Turbine Operations and Maintenance.
OSW	University of Strathclyde	Electrical infrastructure and control design of MRS wind turbines for grid integration	To be confirmed	One innovative design for large multi-MW wind turbines currently investigated by academia and wind industry is the multi-rotor system wind turbine (MRS). The MRS concept

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				enables the use of many smaller rotors to maximise energy capture area at minimum rotor volume making dramatic weight and cost reduction feasible (as long as best possible technology is exploited in the design of smaller systems). Other advantages of multi-rotors include standardisation of components leading to cost reduction, better distributed and generally reduced system loads, enhanced control possibilities and improved logistics for assembly and maintenance. The MRS structure to be addressed in this research consists of a single structure containing multiple rotors of a more manageable size and power rating which when combined achieves the same total electrical power output of a single-rotor machine.
OSW	University of Strathclyde	Forecasting and Analytics for Offering Frequency Response From Wind	To be confirmed	Power systems require a range of ancillary services in order to maintain reliable and economic transmission and distribution of energy. As the penetration of renewables increases the demand for many services is also increasing, while at the same time incumbent providers of ancillary services, large thermal plants, are being displaced. This challenge is widely acknowledged and the ability of wind and other low carbon technologies to provide frequency response, reactive power, reserve energy, and other services is receiving attention from both academia and industry. This project will address the challenge of offering and procuring frequency response from wind turbines whose future capability to deliver this service is uncertain as a result of the variability and limited predictability of the wind resource. Unlike energy which is traded in discrete blocks (30-minute periods in GB), frequency response must be continuously available at a predetermined level during a delivery period (4-hour period emerging as European standard). This presents a challenge for wind farm operators offering this service who must forecast their capability in advance. Furthermore, there are likely to be benefits from offering frequency response services

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				from a combination of wind turbines and battery energy storage, and from aggregating multiple wind farms. This research is extremely timely as new markets are emerging for frequency response which are designed to enable entry by wind and other unconventional providers of frequency response, notably in the all-Ireland power system and in GB. In GB, National Grid is reforming frequency response procurement with a view to procuring frequency response in a day-ahead auction. A 24-month trial of this new mechanism is scheduled to begin in Summer 2019.
OSW	University of Strathclyde	High Fidelity Modelling of Wind Turbine Main-Bearing Operational Loads	To be confirmed	State of the art design methodologies for turbine main bearings are still entirely focussed on linear fatigue theory. The very high rate of failures seen in the field seem to be a clear indication of the unsuitability of this linearity assumption. However, there does not currently exist an alternative metric by which more complicated failures, resulting from shock loading and wear, can be expressed in a statistical sense from which expected lifetimes may be determined. The extension of existing theory to account for realistic loading conditions experienced by wind turbine main-bearings has huge scope to lower the levelised cost of energy since it would allow for improved lifetime prediction, the development of new and more sophisticated testing procedures for bearing certification and would certainly contribute to improvements in design methodologies. This PhD will therefore initially develop high fidelity FEA models of various wind turbine main bearing designs before applying them in order to study in detail the possibility for one of the following outcomes (chosen by the student): -Development of main-bearing dynamic damage metrics and remaining lifetime prediction approaches -Development of new procedures for main-bearing testing and certification which account for realistic dynamic loads (including accelerated testing) -Main bearing design analysis based on realistic loading, including comparisons of existing designs and the development of new solutions to reduce harmful loads (e.g. the potential for additional mechanical damping).

PhD projects in Offshore Renewable Energy

Information provided correct as of June 2020

Sector	University (A-Z)	Title of PhD thesis	Financial support from industrial sponsor? (Y/N)	Description & key aims
OSW	University of Strathclyde	Optimising the utilisation of subsea cables in GW offshore wind farm collectors	To be confirmed	The development of wind turbine technology has resulted in the installation of larger offshore wind farms located at greater distances from shore. As wind farms increase in size, it becomes crucial to maximise efficiency throughout the electrical collector in order to keep costs and losses to a minimum. The main function of the electrical collector is to collect power from each wind turbine generator and transmit it to the offshore substation(s). The array layout and electrical collectors must be designed on a site-specific basis to achieve a good balance between electrical losses and wake effects. In addition to electrical and wake losses there is an issue related with the effective utilisation of the subsea cables; they need to be rated sufficiently assuming full wind turbine power output, however, it is anticipated that cables will be underutilised for a significant time due to low capacity factors of wind farms. Nowadays, the cost associated with offshore cables for offshore wind farms is around 10-15% of the total cost of the project. As such, finding solutions to minimize the cost associated with offshore cables and hence, decreasing the capital expenditure of offshore electrical collectors is highly desirable for future MW offshore wind farm deployments.
OSW	University of Strathclyde	Design of VSC converters connected to variable SCR grids	To be confirmed	The connection point of an HVDC link converter station or PV/wind farm might be located in remote areas where the AC grid presents a low Short Circuit Ratio (SCR). The SCR is an index used to measure the strength of the grid where usually it is around 3 to 20 for standard grids, but in remote locations, it can be 2 or lower. In this situation, the standard controllers for VSC converters might present stability issues, especially when the demanded power is higher than 0.7 pu. In the literature, new control schemes have been suggested to overcome this situation, but for the major part of them are optimised for a fixed SCR. The proposed aims are to analyse, design and validate a new controller, including the SCR detection, for CSC converter connected to a weak grid considering the SCR variation. The new controller will be validated using simulations as experimental validations. At the end of the PhD, it is expected to have an industrialisation ready controller.

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Sector	University (A-Z)	Title of PhD thesis	Financial support from industrial sponsor? (Y/N)	Description & key aims
				During the PhD the student will design, build and programme an experimental platform to validate the obtained results. The experimental platform will be based on a low power two level converter and will have a configurable set of inductances to emulate different SCR. In this way, the transition between different SCR and the dynamic stability for a particular SCR can be studied.
OSW	University of Strathclyde	Computational modelling of leading edge erosion of turbine blades by droplets and solid particles impacts	To be confirmed	Wind energy has been developed significantly over the past two decades. It contributes to nearly 20% of the total electricity produced in the UK. In 2018 Q1 onshore wind energy generation increased by 27 per cent and generation by offshore wind increased more than a half and similar trends are observed in the EU. Large wind turbines consist of several blades with airfoil shaped cross sections to generate lift to maintain the rotation of the blades. The blades are naturally subjected to high-speed winds and are bombarded by solid particles and/or water droplets depending on the installation site. Such impacts, increase the surface roughness by damaging the surface coatings. Initially, this damage substantially reduces the aerodynamic performance of the blades by increases the friction drag and causing an earlier onset of stall. As the severity of erosion increases there is a risk of diminishing structural integrity of the blades and eventually, the blade should be replaced resulting in turbine downtime and high maintenance costs. A major issue here is a lack of predictive models at the design stage of the blades. Although the blades can be optimised for aerodynamic performance, the effects of erosion are not normally considered in this stage. However, it is obvious that the motion of particles near the blades and hence the impact mechanics is essentially a fluid dynamics problem and could be considered as a part of the aerodynamic design stage to minimise the probability of erosive impact. Such optimisations will prolong the lifetime of the blades. Nonetheless, the damages will eventually accumulate and maintenance is required. A predictive tool to assess the erosive impact can also be invaluable here. It allows us to estimate the extent of the damage and plan for maintenance in advance. Avoidance of any unplanned shut down, substantially reduces the maintenance costs.

PhD projects in Offshore Renewable Energy

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Sector	University (A-Z)	Title of PhD thesis	Financial support from industrial sponsor? (Y/N)	Description & key aims
OSW	University of Strathclyde	Advanced Non-Destructive Testing of Blade Manufacturing Defects	To be confirmed	Wind turbine blades are one of the most costly and complicated components of the wind turbine. Blades are now approaching 100m in length and are manufactured using carbon and/or glass fibre reinforced plastic composites. Non-destructive testing (NDT) methods are utilized to identify defects so to reduce operational maintenance costs and extend lifetimes.Ultrasonic testing techniques are the most suitable NDT method with the data/image analysis typically performed by trained NDT experts. The aerospace industry now employs improved, contactless scanning methods, coupled with detection algorithms and machine-learning techniques. The application of similar methods to large wind turbine blades will enable more efficient and cost-effective inspections resulting in overall benefits for clean energy production.A review of current ultrasonic NDT techniques for composite materials will be conducted and the most applicable for the wind industry identified. These will be tested on small blade samples, provided by industrial partner Siemens Gamesa Renewable Energy. Following on from this, processes are to be up-scaled with the aim of developing mature and fully automated inspection, and image analysis, techniques used in large-scale blade manufacturing.
OSW	University of Strathclyde	Stability and autonomous control of wind farms connected to HVDC	To be confirmed	Increasing capacity in offshore wind, combined with growing distances to farms, means that HVDC transmission is increasingly vital for connection of offshore renewable resources and the interconnection of national networks. Large wind farms are now also required to assist with grid support and regulation of voltage and frequency, despite being dependent on a resource that does not fluctuate with grid demand. To ensure secure grid operation in the future, new and robust methods for controlling wind farm power injection to weak AC grids via HVDC must be developed. This project seeks to review existing control methodologies for VSC-HVDC transmission and investigate the emerging challenges associated with intermittent renewable resources, VSC-HVDC and weak AC grids. Robust, co-ordinated VSC-HVDC control methods will then be developed, simulated and optimised. Performance of these controllers in abnormal operating conditions, and the fault ride through capability of connected wind farms, will also be examined.

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Sector	University (A-Z)	Title of PhD thesis	Financial support from industrial sponsor? (Y/N)	Description & key aims
OSW	University of Strathclyde	Considerations on retrofitting VSM algorithms within operational windfarms on standalone solutions at the connection point	To be confirmed	The increasing penetration of converter interfaced generation (CIG) is leading to issues such as low inertia and weak grids. Grid forming converters, including virtual synchronous machines, provide a solution that can often be implemented retrospectively to existing CIGs. This PhD aims to study the technical challenges associated with different configurations of virtual synchronous machine control (and their alternatives) to determine the optimal means of deployment. The study will include a focus on energy storage systems and the necessary sizing of these components. The ultimate goal of the project is to produce a techno-economic analysis that identifies the most cost-effective solutions.
OSW	University of Strathclyde	X-Rotor Wind Turbine Development		The continuing pressure to reduce the CoE of offshore wind has renewed interest in novel offshore wind turbine concepts with the potential to reduce CAPEX, OPEX or both. One such concept, originating in Wind Energy Control Centre (WECC) in the University of Strathclyde, is the X-Rotor Offshore Wind Turbine, a radical rethink of VAWTs and HAWTs to form a hybrid concept addressing their individual disadvantages whilst maintaining their advantages. Over the last two years a feasibility study, funded by the Royal Academy of Engineering and the EPSRC, has established that the X-Rotor concept has the potential to reduce the CoE by up to 30% in comparison to a conventional HAWT. The feasibility study of the X-Rotor, however, has only been on conservatively determining performance, loading and weight of main components to inform CoE estimates, in part due to the absence of suitable design tools such as BLADED. Therefore, the present research focuses on the development of an aero-elastic code for the X-Rotor concept, in order to conduct in-depth investigations of the aerodynamics, loads and structures, since very little lies within the existing boundaries of wind energy science.
OSW	University of Strathclyde	Floating Wind Turbine Maintenance Requirements, Strategies and Floating Crane Design	To be confirmed	With the installed capacity of floating wind expected to increase significantly over the next decade, there are still many operation and maintenance questions that must be answered before it can become cost-competitive with fixed bottom offshore wind. One of these relates to how how heavy lift operations can be completed optimally for main turbine components.

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Supergen Offshore Renewable Energy

Sector	University (A-Z)	Title of PhD thesis	Financial support from industrial sponsor? (Y/N)	Description & key aims
				The aim of this project is to determine the heavy lift maintenance requirements, the optimum heavy lift maintenance strategy and and complete an initial, concept design for a floating crane for floating wind turbines greater than 7MW. This will involve collaboration with industrial and academic partners on the project, different departments within the University of Strathclyde, and will build on the extensive expertise that has already been built up within the university on offshore wind operations and maintenance.
OSW	University of Strathclyde	Predictive Analytics for Short-term Wind and Solar Power Forecasting	To be confirmed	Forecasts of renewable power generation are required for economic and reliable power system operation. In the very-short-term, forecasts are produced by statistical models of generation patterns, including the spatio-temporal dynamics of multiple wind or solar farms in the same region. When forecasting further ahead, meteorological forecasts are used as inputs to predict the output of wind and solar farms. These forecasts are used by participants in electricity markets and by power system operators on a continuous basis to maintain the balance of electricity supply and demand. This PhD aims to develop improved forecasting methodologies by exploiting contemporary statistical methods for processing large quantities of explanatory data including numerical weather predictions and the wide range of measurements made a wind and solar farms, many of which are available in close to real-time.
OSW	University of Warwick	Vibration suppression of floating wind turbines	N	Investigate the vibration reduction of floating wind turbines using passive devices
OSW	University of Warwick	Modelling and control of smart rotor	N	Develop a smart rotor model and apply data-driven control method to drive its controllable flaps
OSW	University of Warwick	Machine learning based prediction for ORE farms	N	Develop advanced artificial intelligence based prediction algortihms and apply them for the predictions of power output and structural load of ORE farms
OSW	University of Warwick	Dynamic wind farm wake modelling	N	Develop a dynamic wind farm wake model with the main features of unsteady wind turbine wakes, which is suitable for control design
OSW	University of Warwick	Control of offshore wind farms	N	Develop advanced predictive control methods and apply them to the offshore wind farm control

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