Research Activities.

Each REU student will work with (at least) one faculty advisor and (at least) one IGERT PhD mentor. Here we present twelve example research projects in some detail, overview in Table 1. The specific research projects will depend on the background and interest of the REU applicants and the evolving research among the IGERT faculty and graduate students.

Table 1 Overview of potential projects.

Potential Project	Area	Leading Professor	Special Student qualifications/interest
Fluid-Structure interaction of mooring systems	Mechanical Engineering	Modarres	Lab experience
Bio-based Materials for Offshore Wind Turbine Blades	Materials Science and Engineering	Clouston	Chemistry
Electric Grid Reliability with Wind and Solar	Industrial Engineering	Baker	Excel programming
Habitat Use of Breeding Bald Eagles	Environmental Science	Griffin	GIS experience
Spatial Ecology of Marine Birds & Mammals	Environmental Science	McGarigal	interest in marine fieldwork & GIS
Tracking Movements of Common Terns	Environmental Science	Sievert	interest in fieldwork
Cumulative adverse effects of offshore wind energy development on wildlife	Socio-Environmental Science	Milman	GIS experience
Understanding public acceptance and rejection of offshore wind energy in Massachusetts	Socio-Environmental Science	Markowitz	
Automated Development of Models from Observational Data	Mechanical Engineering	Danai	
Optimization of Wind Turbine Rotor Design for Floating	Mechanical Engineering	Lackner	
Analysis and Assessment of Offshore Compressed Air Energy Storage	Mechanical Engineering	McGowan	
Foundation and Support Structure Design for Offshore Wind Turbines	Civil Engineering	Arwade/DeGroot	

Fluid-structure interaction of mooring systems in floating wind turbines

Significance. In an offshore floating wind platform, the mooring lines are used to maintain and stabilize the position of the turbine and counteract the turbine's thrust, torque and yaw loads. A reliable and stable mooring line is crucial in the design process of an efficient offshore wind turbine.

Theoretical framework: A mooring line can be considered as a bluff body placed in flow. This constitutes a canonical problem in fluid-structure interaction, known as vortex-induced vibration (VIV). VIV has been studied extensively for simplified and for systems with symmetry (Bearman, 1984, Williamson et al 2014). A mooring line of an offshore wind turbine, however, is a three-dimensional and asymmetric system. There are several fundamental studies that need to be done to answer questions on how one can relate the existing knowledge on VIV to the cases with flexible, three-dimensional and asymmetric systems. A tapered cylinder, an inclined cylinder or a curved cylinder (Fig 2) placed in flow are samples of asymmetric system undergoing VIV (Jain et al., 2013; Seyed-Aghazadeh et al., 2014). Fatigue life is an important question for any system undergoing VIV, including mooring lines. The challenge is to avoid catastrophic failure without overdesigning the structures. This calls for better prediction methods for the fatigue damage due to VIV.

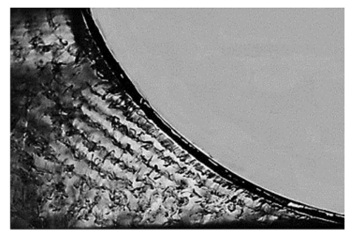

Fig. 1. Vortex shedding downstream of a curved cylinder undergoing VIV

REU projects: The first REU student will design and build an experimental set-up for VIV of clustered flexible cylinders, a direct analogue to the design of mooring systems. This will provide several options in terms of the number, orientation and proximity of the mooring lines. Detailed drawings will be prepared and different pieces of the set-up will be built using either 3D printing methods or traditional machining. The REU student will test the final assembled set-up in the water tunnel and adjust the design if necessary to meet the requirements for extensive future tests. The second REU student will help conduct experiments on VIV of flexible structures. The tests will start with a single flexible structure placed perpendicular to the flow in order to have a basis for comparison. This will be done using an existing experimental set-up. Then several different configurations for clustered cylinders will be tested. The REU student will use two high speed cameras to record the cylinders motion, track several points on cylinders and analyze the resulting VIV time histories.

Bio-based Materials for Offshore Wind Turbine Blades

Significance: Bio-based materials could offer both substantial cost and weight reductions as compared with fiberglass, and they address a growing public concern for continued use of nonrenewable resources. Small-scale wooden wind turbine blades have met performance requirements for decades. With today's technological advances in bio-based materials, it is time to look for ways to integrate them into large-scale wind turbines.

Theoretical Framework: Wood and other bio-based materials are not typically considered for high-performance composite applications such as wind turbine blades, which exemplify many important challenges of designing with composite materials, such as material fatigue, anisotropy, and complex stress states. Thus, these blades are an ideal case for which to apply modeling techniques being developed and experimentally verified for the design of high-performance bio-based composite materials.

Fig. 2. Angle-ply wood laminate torsion test specimens fabricated and tested at UMass in 2014

REU projects: The first student will investigate the design of the wind turbine blade spar, using the current version of the Finite Element Model in ANSYS and updating the wood laminate spar to include spar caps made from a bio-based composite such as a flax- or hemp fiber-epoxy (Koh et al., 2014). She will use the FE model to design the caps for optimal material, grain angle, and thickness. The second student will fabricate and test the torsion specimens using a methodology developed at UMass (Yang et al., 2013). Together, both students will test the design for torsional shear strength in the material test machine. Research questions include: What is the optimal design considering material type, thickness, and grain orientation for the spar cap? What are the mechanical properties of the optimal design? How accurate is the model in predicting the experimental behavior of the hybrid spar and cap assembly? What are the physical properties of the tested spar caps? How do manufacturing processes influence the physical and torsional properties of bio-based composites?

The Reliability of the Grid with wind and solar energy.

Significance: Ensuring a reliable supply of electricity is key when looking at integrating renewable energy to the power system. Due to its variable nature there many systems operators have limited the amount of wind and solar generation that can be incorporated into the grid. We aim to develop a model that can calculate the expected level of reliability for various generation portfolios prior to integrating wind to the network.

Theoretical Framework: Although reliability is a high priority, it is often a retroactive process. Capacity value, effective load carrying capacity, and loss of load expectation are three of the most common reliability metrics used in the power system literature. Milligan and Porter (2008) discuss how to determine the capacity value of wind, while Wen et al (2009) provides a review of the different reliability metrics used for reliability evaluation of wind. These two papers provide the basis for our reliability evaluations.

R**EU Project:** The aim of this REU project is to develop a method of calculating the expected reliability of a generation mix. Over the course of the summer the REU student will gather wind, solar, and demand data from the New England area across multiple years. We will then determine the expected generation of a wind or solar farm from a given capacity level. The REU student will then take this data and calculate reliability metrics for different generators (i.e. wind, natural gas, and solar). We will then expand that to calculate the expected reliability of a given portfolio.

Spatial Ecology of Marine Birds and Mammals in the Gulf of Maine

Significance: The Gulf of Maine's (GoM) coastal marine ecosystem is one of the most ecologically and economically productive ecosystems in the world, and it boasts the greatest wind energy potential in the region. As offshore wind development plans proceed, we face a critical need for ecosystem data to guide plans in a way that will ensure the long-term conservation of habitats, organisms and ecosystem processes in GoM coastal waters.

Theoretical Framework: Together, species niche theory, source-sink dynamics theory and metapopulation dynamics theory provide the necessary framework for understanding why species are where they are, but all emphasize the importance of quality habitats. Many recent species conservation efforts have focused on habitat protection (Prendergast et al., 1999; Margules and Pressey, 2000; Rands et al., 2010). These protected habitats not only create the space needed for a species to survive, reproduce, and interact, but they also block potential threats to these processes (Rands et al., 2010; Butchart et al., 2010). The next challenge is identifying which habitats to protect. This requires a robust assessment of the habitat needs of fish, benthic organisms, seabirds, and marine mammals within GOM.

REU project: This student will participate in the at-sea surveys as part of the on-going project to map the biological hotspots in the GoM, a project supported by the State Wildlife Grants Competitive Program. The REU student will collect data on marine birds and mammals along fixed transects using range-finder binoculars and angle estimators as part of the project's marine survey. The student will identify, count, and document behavior of each marine bird and marine mammal within a standard 150m wide strip using distance sampling (Tasker et al., 1984). Presence data will be entered in real-time on a computer connected directly to a GPS unit using the program DLog (R. G. Ford Inc., Portland, OR), such that each sighting has a specific time and location stamp. The student will analyze these data using the distance program v 6.2 (Thomas et al., 2010) with co-variants to estimate the density of marine birds and mammals, and map their distribution using ArcGIS v. 9.3 (ESRI, 2008). Specific research questions for this project include: a) do marine bird and mammal hotspots overlap, and b) to what extent do these ecological hotspots overlap with high potential wind energy sites in the GoM?

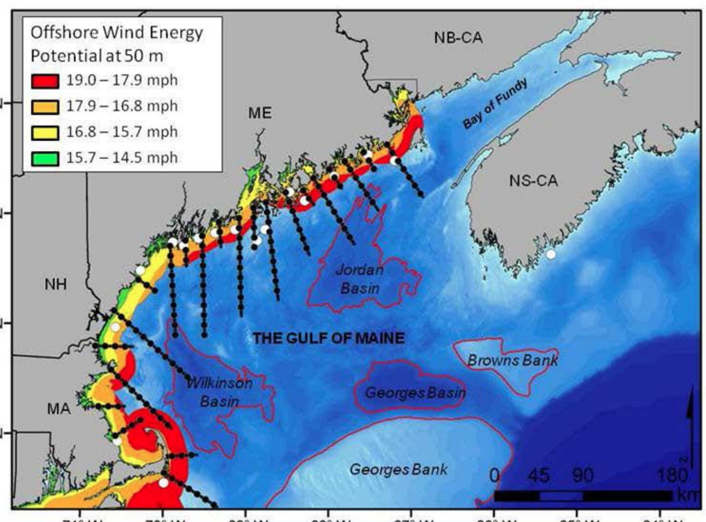

Fig. 4. Gulf of Maine coastal marine ecosystem multidisciplinary at-sea survey transects (black lines) and cast stations (black circles).

Habitat Use Analysis of Breeding Bald Eagles near Current Wind Energy Facilities

Significance: Bald eagles are protected and managed under several federal laws that prohibit take (defined as the killing, harassment, molesting, etc.) unless authorized by the US Fish and Wildlife Service (USFWS). The Eagle Conservation Plan Guidance (ECPG; U.S. Fish and Wildlife Service, 2013) attempts to predict direct and indirect effects of potential wind facilities by monitoring eagle utilization rates, breeding productivity, and mortalities during all stages.

Theoretical Framework: One principal focus of the ECPG is calculating eagle fatality estimates at proposed wind energy projects through collision risk models (e.g. Band et al., 2007), based on observational survey data, and adjusted by avoidance rates (Smallwood and Thelander, 2008). With only six bald eagle deaths from wind turbine collisions reported in North America, it is impossible to evaluate relative vulnerability of bald eagles to collisions or calculate empirically-derived avoidance rates. Thus, there is a critical need to develop alternative models that will enable more accurate predictions, especially multifaceted models that directly incorporate habitat use or potential behavioral adaptations by eagles.

REU project: This student will participate in systematic observations of eagle behaviors at eagle nests in Maine, conducting focal observations of GPS-tagged birds to assess eagle behavior and GPS location accuracy under various environmental conditions. Comparing telemetry data to simultaneously-recorded observational data will help to validate statistical models and relationships between GPS data and behaviors (Hebblewhite and Haydon, 2010). Additionally, the REU student will conduct a GIS analysis that compares the GPS movement paths with simulated data from the ECPG's recommended "point-count" observational surveys. The specific research question for this project is: a) does the efficacy of various observational survey parameters (e.g. survey area size, duration, and frequency) accurately detect eagles utilization rates. Testing this relationship will provide the opportunity to assess variations in observational methods and recommend improvements in survey techniques.

Tracking Movements of Common Terns in Nantucket Sound

Fig. 5. Common tern with back-mounted nanotag.

Significance: Several wind energy facilities are currently planned for offshore Atlantic waters of the U.S.. Under Federal laws, regulatory agencies such as the Bureau of Ocean Energy Management (BOEM) and the U.S. Fish and Wildlife Service (USFWS), are required to protect populations of marine birds that frequent these areas (O'Connell et al., 2009). There is a need to collect information on distribution and behavior (e.g., flight paths, timing) from a broad suite of birds in these areas, particularly for species of conservation concern.

Theoretical Framework of larger project: Studies that use telemetry to track individual birds provide spatial and temporal data on flight paths and distribution, which is needed to identify how birds use areas where wind facilities will be located. This baseline information is essential for evaluating negative interactions between birds and offshore turbines that could occur after an offshore wind facility is built. Tracking information can also be used to identify where high concentrations of birds occur and better understand factors (e.g., seasonality, food, weather) that influence their distributions, allowing regulators and managers to place future offshore wind energy facilities in areas with the lowest predicted impacts (Drewitt and Langston, 2006; O'Connell et al., 2009; Burger et al., 2011).

REU project: This student will participate in capturing, tagging, and monitoring common terns in Nantucket Sound. They will capture terns on their nests; band and attach a back-mounted VHF nanotag. The REU student will regularly monitor all tagged birds at their nests to confirm that each individual shows no overt physical problems, is incubating or caring for chicks normally, and has retained its nanotag. Specific research questions for this project include: a) do tags affect the productivity and behaviors of nesting terns, and b) to what extent do terns utilize the proposed wind farm site in Nantucket Sound.

Cumulative adverse effects of offshore wind energy development on wildlife: evaluating the exposure of vulnerable birds to future build-out scenarios

Significance: While the effects of one offshore wind energy development (OWED) on wildlife may be limited to individuals, the effects of large-scale deployment (such as the DOE's goal of 54 GW by 2030) may be cumulative, leading to adverse impacts on wildlife populations (Goodale and Milman, 2014). With the exception of a 1/8th scale floating prototype tested in Maine, there are currently no installed OWEDs in the United States. Thus, there remains the opportunity to reduce adverse effects through careful analysis and decision-making.

Theoretical Framework: The effects to wildlife from OWED can be direct (mortality and injury) or indirect (impacts on habitat, migration patterns) and are caused by hazards such as noise from pile driving, boat traffic, and lighting (Crichton, 1999). These adverse effects then accumulate additively, synergistically, or antagonistically to cause population level effects, or cumulative adverse effects (CAE). This project aims to bring together research on OWED-Wildlife interactions with information on potential OWED development to develop novel methods for assessing CAE using scenarios and geo-referenced data.

REU project: The student will assist in development of plausible OWED build-out scenarios along the east coast of the U.S. during the next 50-100 years, and in analyzing how exposure to these scenarios will affect the populations of Northern Gannet, Red-throated Loon, Surf Scoter, and Peregrine Falcon. We will identify and collect key engineering parameters (bathymetry, distance from shore and population centers, wind conditions, etc.) and input these into a geodatabase, allowing for geospatial analysis to identify potential locations for OWED. Next, population estimates and demographic parameters on targeted bird species will be collected from literature and used as inputs for a population vulnerability analysis. The specific questions of this research project include: what are the potential geographic layouts of OWED along the east coast and, for each, what cumulative effects may accrue to the populations of interest.

Understanding public acceptance and rejection of offshore wind energy

Significance: Underlying psychological, cultural, economic and other factors influence acceptance and rejection of new technologies, including offshore wind energy. Understanding how these factors contribute to shaping individuals' and communities' opposing positions on proposed offshore wind projects can help point the way towards effective strategies for resolving conflict, for framing the problem, and making meaningful progress on this issue.

Theoretical framework: Considerable research across the social sciences has identified numerous factors that influence how individuals and communities engage with, think about and ultimately take action on new technologies (cf., Hall & Kahn, 2003), including those related to electricity generation (e.g., Wolsink, 2007). Multiple factors (norms, social capital, etc) interact to influence individuals' and communities' perceptions of risk and benefit, their willingness and motivation to take action and ultimately their support or rejection of proposed projects (e.g., Slovic, 1980). Offshore wind energy projects pose a number of unique questions and challenges in this context (Devine-Wright, 2005). There is a critical need to understand how competing values (e.g., preserving landscapes vs. reducing fossil fuels) and information interact in the context of implementing offshore wind energy projects. Moreover, insights from past and ongoing efforts to identify the most important drivers of public engagement in the context of offshore wind energy projects (e.g., Devine-Wright, 2005; Perlaviciute & Steg, 2014) can be leveraged to develop innovative messaging strategies that will help diverse stakeholders in this debate come together on this issue. Effective issue framing has the potential to shift public discourse and thinking about wind energy in a new, productive and inclusive direction (cf., Nisbet, 2009).

REU projects: The first student will participate in the development and implementation of survey research efforts aimed at identifying underlying psychological and other factors that shape public acceptance or rejection of offshore wind energy projects in Massachusetts. The student will help to collect survey data as well as conduct a few in-depth "on the street" interviews with state residents. The second student will participate in the development and testing of experimental message framing studies. They will assist in identifying promising new frames, developing materials to test those frames and implementing message testing studies with residents around the state. Specific research questions for these projects include: how do individuals who hold conflicting beliefs and attitudes towards offshore wind energy resolve those conflicts; what are the key factors that predict acceptance or rejection of specific proposed projects in the state; what are the existing frames used by opponents and advocates of offshore wind energy in Massachusetts; and are there new or previously untested frames that may speak to both sides of the debate over offshore wind energy.

Automated Development of Models from Observational Data

Significance: Scientific advancements depend on the ability of human experts to understand and mathematically describe the behavior of the dynamic systems they study. However, in today's world, the rate of data collection far outpaces the rate at which experts can process the data to gain insight into the behavior of the measured systems they wish to understand. In addition, many of the systems that are not well understood are nonlinear, chaotic, highly coupled, or characterized sparsely by measurements, making expert inference of the appropriate models even more difficult. For these reasons, automated dynamic modeling approaches are needed. These approaches must fulfill the requirements of accurately describing the measured processes in a succinct and general way, and advance the understanding of underlying physical processes. To this end, we wish to engage scientists from various disciplines to develop models for the systems they study through the application of novel approaches to automatic system identification.

Theoretical Framework of the Project: The project concerns the development of automated system identification methods. At the heart of system identification is the challenge of identifying the dynamic model form (topology) and its parameters, often referred to as symbolic regression. We address this challenge at two levels. At the first level, developed for poorly understood systems, the method DevelEp is devised to conduct symbolic regression without prior knowledge of the model form or its parameters. This method relies on a developmental, linear genetic programming strategy to incorporate epigenetic learning into its search mechanisms. Using Lamarckian findings in biology as inspiration, epigenetic properties are learned with an epigenetic hill climber while evolved with the population. The proposed method is shown to result in faster convergence and more efficient search of the dynamic model than the available methods. At the second level, a model structure adaptation (MSA) method is developed for better-understood systems for which first principles models are available. The proposed method uses gradient-based adaptation to improve the model form for improved predictive ability while maintaining its intelligibility.

REU project I, for a more senior student: This student will help with the application of the methods to new environments. The work will entail modifying the algorithms within the system identification code, and analyze and test these algorithms using new application problems. The student will be responsible for prototyping modules within DevelEp, and take an active part in the program’s development. The student will learn the foundations of genetic programming, symbolic regression, and the fundamentals of evolutionary computation while also being exposed to current research in genomics.

REU project II, for a more junior student. This student will be responsible for helping to identify and contact researchers in other disciplines with modeling needs. The student will work with these researchers and our software packages to preprocess the collected data and set up the input files for the software. The students will then report on the significance of the proposed models and will learn about other disciplines and will gain valuable skills in data analysis, system identification, and analytical thinking.

Optimization of Wind Turbine Rotor Design for Floating Offshore Platforms

Significance: Wind turbines on offshore floating platforms operate in a more unsteady environment than typical onshore systems. Wind and wave loading cause platform motion which effectively adds an additional unsteady component to the instantaneous velocity at the wind turbine blades. As a result, floating offshore wind turbines (FOWTs) experience a more complex aerodynamic operating environment and see increased peak and fatigue loads compared to onshore or fixed bottom offshore systems, reducing reliability. The goal of this work is to optimize wind turbine blades for the floating offshore environment that can mitigate loads while maximizing rotor efficiency.

Theoretical framework of larger project: Recent work at UMass Amherst has coupled the aero-elastic model FAST with our in-house free vortex wake aerodynamic model, WInDS. WInDS will improve FAST simulations of FOWTs since it more rigorously accounts for the unsteady aerodynamic loads resulting from platform motion and complex interactions with the rotor wake. As a result, we will have more insight into the coupling between the rotor aerodynamics, platform motion, and blade deflections, improving load predictions. Blade parameters such as chord, twist, and airfoil distribution can be adjusted using multi-objective optimization techniques to minimize loads while maximizing power output of FAST/WInDS simulations. Research questions include: (A) how do the solutions for different optimization techniques differ, (B) what optimization technique reaches an acceptable solution in the minimal number of load case iterations, (C) how do optimized blades differ for different floating platform types, (D) what load reductions and power improvements can be achieved for different floating platform types?

REU project I, for a more senior student: This student will primarily investigate the optimization techniques to be applied and how they affect the solution. Aero-elastic load simulations of wind turbines are time intensive so emphasis will be on reaching an optimal solution with a minimum number of iterations. This student will program the optimization algorithms and define the parameters and bounds for the optimization load cases to support a more junior student. Specifically research questions A and B will be answered.

REU project II, for a more junior student: This student will be responsible for running FAST/WInDS simulations using the optimization techniques developed by the more senior student. Different floating platform designs will be simulated due to their unique platform motion profiles. The focus will be the analysis of the resulting simulation data and optimal blade designs. This student will work with large data sets using tools like charts and summary statistics. Specifically research questions C and D will be answered.

Analysis and Assessment of Offshore Compressed Air Energy Storage

Significance: Plans for integration of high penetration levels of often variable and uncertain renewable energy, like offshore wind, pose significant challenges to utility gird operators and system planners. The intermittent nature of renewables can result in dramatic changes in system load, indicating a need for large-scale energy storage technologies that would allow renewables to be dispatched when needed. Among utility-scale storage technologies, Pumped Hydro Storage (PHS) and Compressed Air Energy Storage (CAES) are two cost effective, proven technologies suitable for providing extended durations of energy storage with fast ramping rates and good part-load operations

Theoretical Framework of larger project: Previous works by others have shown CAES to be an effective way of mitigating the uncertainty and variability inherent in renewable generation and others have evaluated many advanced CAES systems, primarily directed for terrestrial applications. However, in addressing the area of offshore CAES and case study integration is lacking.

Project I, REU senior student: For this project, the student will support development by investigating the offshore resource potential of different UW-CAES models derived by the first law of thermodynamics using ESRI's ArcGIS Geographic Information Systems (GIS) software. ArcGIS is a comprehensive system that allows people to collect, organize, manage, analyze, communicate, and distribute geographic information. Using the Spatial Analysis extension in ArcGIS, UW-CAES energy storage maps will be created and analyzed to determine the theoretical resource potential by defining resource classes based off of water depth and distance from shore. Furthermore, several different raster layers such as soil structure, transmission grid, environmental layers, and major fishing spots will be created using existing source GIS data will be integrated into the program to help identify potential hotspot areas of conflict and concern. Last, the idea of structured decision making will be introduced to the student to help them understand and think through multidimensional choices characterized with siting offshore energy development and the inherent uncertainty, diverse stakeholders, and difficult trade-offs associated. Specific research questions for this project include: How does the UW-CAES resource potential differ between compression models? What implications to the resource potential arise when other layers of concern are included in the analysis and areas are buffered and excluded?

Project II, REU junior student. This student will help collect and organize GIS and offshore meteorological data from NOAA buoys to support a case study implementation for the Gulf of Maine. The student will perform research to identify potential GIS layers of concern for the case study area such as: electrical transmission grid infrastructure, environmental and wildlife refuge areas, ports, boating and fishing routes, bird breeding areas, and soil structure layers. This student will collaborate with the senior REU student, an IGERT PhD student, and a faculty member on how prepare and organized the data for use in the program. The student will also work with some meteorological data for use in the model using pre-coded scripts. Specific Research Questions for this project are: How can one prioritize the different GIS layers based on the UW-CAES technology and proximity to wind resources and load centers? How does the wave and wind data co-align UW-CAES storage resources? What about aligning with regional load data?

Foundation and Support Structure Design for Offshore Wind Turbines

Significance: Foundations and support structures make up approximately 20-25% of the capital cost of an offshore wind farm, thus improvements in design and analysis have a large potential impact on offshore wind energy economics.

Theoretical Framework of larger project: Marine growth on offshore wind turbines causes the substructure (portion of support structure under water) to increase in surface roughness and mass. This presents two issues: 1) increased surface roughness creates more drag on the substructure, which increases loads due to waves and current and 2) increased wind turbine mass moves the natural frequency of the structure closer to wave frequencies, which also increases loads. Research questions include: What significance does marine growth have on offshore wind turbine loads and natural frequency?

REU project I, for a more senior student. With the help of a PhD student and a more junior student, this student will gather information from literature on marine growth with specific attention to the relationship between marine growth and surface roughness. The student will then investigate the sensitivity of the wave and current loading due to surface roughness (drag) using Morison's equation. Specific Research Questions for this project are: What level of marine growth is significant to structural design for offshore wind turbines? How does the increase in surface roughness vs. the increase in substructure diameter (due to growth) compare with respect to loads?

REU project I, for a more junior student. This student will assist the more senior student in gathering information on marine growth, with specific attention to marine growth accumulation/growth rate) and the associated mass. This student will then use Matlab code (provided by a PhD student) to investigate the sensitivity of offshore wind turbine natural frequency to the increased substructure mass. Specific Research Questions for this project are: How quickly does this growth accumulate? How much does marine growth affect natural frequency?

Theoretical Framework of larger project II: Even under best practice, there is inherent uncertainty in offshore geotechnical site investigation. Offshore geotechnical site investigations typically use Cone Penetrometer Testing to identify offshore soil profiles, using correlations to convert CPTU data into soil property data. Depending on the site, CPTU data interpretation can significantly affect soil profile and consequently the foundation design. Research questions include: How does soil profile influence offshore wind turbine foundation design?

REU project II, for a more junior student. Working with a PhD student and a more senior student, the student will digitize CPTU data from an offshore site. This data will then be subdivided into soil layers and converted into soil property information using correlations selected by a professor. Specific Research Questions for this project are: How does CPTU data interpretation influence soil profile?

REU project II, for a more senior student. The soil profiles generated by the more junior student will be used by the senior student to determine the influence of soil profile on foundation performance. With the help of a PhD student, this student will look at how soil profile influences estimations of foundation stiffness and damping. Specific Research Questions for this project are: How does soil profile influence foundation design?