a place of mind
THE UNIVERSITY OF BRITISH COLUMBIA

Supervisor Contact: Prof. Ryozo Nagamune, Ph.D., P. Eng.
Department of Mechanical Engineering
office: 3104 Kaiser Bldg - mail: 2054-6250 Applied Science Lane
The University of British Columbia, Vancouver, B.C. V6T 1Z4, Canada
email: nagamune@mech.ubc.ca, phone 604-827-4344

MECH 493 project: Optimal design of a floating offshore wind farm

Background and research goal

Floating offshore wind farms offer great potential for generating electrical power in a clean and sustainable manner. Despite this potential, one major challenge that is hindering development and implementation in this area is the extremely high cost related to construction, installation, maintenance and operation. Developing innovative methods for increasing the efficiency of floating offshore wind farms is therefore and effective approach to mitigating cost concerns. Specifically, wind farm modeling and control have become hot research topics for maximizing efficiency.

The goal of current project is to develop optimization methods that will lead to the design of floating offshore wind farms with high efficiencies. These algorithms will require inputs that are predetermined based on external conditions and funds (*e.g.* wind velocity data, ocean depths, available ocean surface shape and area, quantity of wind turbines, etc.), and will output floating wind farm design parameters that may be implemented by wind farm developers (*e.g.* wind turbine installation locations, mooring line lengths, mooring system orientations, anchor locations, etc.). These output parameters must be optimal such that annual wind farm energy production is maximized.

Different algorithms will be tested and ranked based on their capacities to maximize energy production and the computational time required for optimization. Example of algorithms include local (*e.g.* gradient descent), global (*e.g.* particle swarm), and distributed (*e.g.* sequential computation) optimization techniques. This project presents an excellent opportunity to learn about wind farm modeling and operation, as well as numerical optimization, which plays a significant role in advanced control, artificial intelligence, and machine learning sectors.

Tasks to be performed by the student

1. Use local optimization methods to maximize energy production from a floating offshore wind farm.
2. Use global optimization methods to maximize energy production from a floating offshore wind farm.
3. Use distributed optimization methods to maximize energy production from a floating offshore wind farm.
4. Analyze and compare the results in terms of energy production and computational time.

Facilities and team:

The student will work with Dr. Ryozo Nagamune and his Ph.D. student Ali Cherom Kheirabadi.