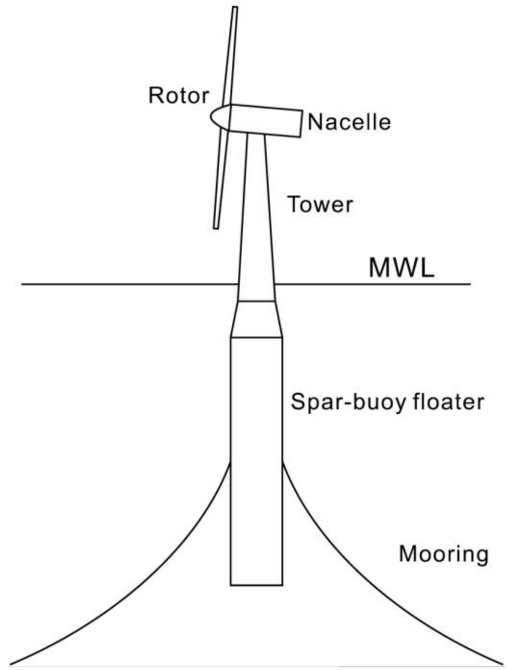
OE44090 – Project Deadline: 14/06/2024

Modelling a Floating wind turbine



Introduction:

In this project, you will utilize the principles learned in the Computational Modelling unit to simulate the OC3 phase-IV spar-buoy Floating Offshore Wind Turbine (FOWT) system. The wind turbine is the reference 5MW NREL turbine and the mooring system consists of catenary mooring lines. The objective is to create a 2D model representing a the structure, considering it as a linear elastic body composed by a point mass (Rotor-Nacelle Assembly), a thin beam for the tower, a rigid body for the floater and a geometrically nonlinear strings for the mooring system. Additionally, you have the option to model the floater as an elastic beam. The simulation will be subjected to typical offshore loads such as wind, waves, and currents.

Learning Objectives assessed in this project:

- **LO1. Construct a Conceptual Model**: Develop a 2-dimensional conceptual model of an offshore structure.
- **LO2. Apply Numerical Methods**: Employ various numerical methods to solve the equations of motion, considering offshore loads.
- **LO3. Implement Numerical Solutions**: Utilize Python or other programming languages to implement numerical methods.
- **LO4. Analyze Results**: Validate against analytical solutions or experimental data, evaluate errors, and assess convergence.

Deliverables:

As a final deliverable you should write a report that does not exceed 15 pages with the sections described below. Together with the report you need to provide an executable file, or notebook, that can reproduce the results reported in the document.

Section 1. Model Definition :

- Obtain dimensions and design the model. Higher complexity in the geometry definition, higher grade (inclusion of all elements has maximum grade).
- Describe governing equations and characteristic loading, including time-dependent wave loading.

Section 2. Numerical Methods:

- Derive discrete formulation using Finite Element Method. Inclusion of terms not discussed in class will be valued positively if their inclusion is properly justified.
- Detail geometry discretization, Finite Element space, shape functions, weak form, boundary conditions, and loading.
- Justify all your choices.

Section 3. Numerical Schemes:

- Implement the discrete formulation, utilizing appropriate time discretization methods. You can use the notebooks given in the lectures as starting point. More efficient implementations will be valued positively.

Section 4. Results Analysis:

- Validate structural deformations with literature data.
- Conduct convergence study (in space) and analyse time stepping.
- Analyze response based on literature's operating conditions.
- Perform modal analysis and relate mode shapes/frequencies to loading conditions.

Additional Requirements:

- Justify choices and provide supporting references.
- Supplement findings with relevant graphics.

Assessment Criteria:

- Quality of the final model (10 points).
- Correct definition and derivation of governing equations and numerical methods (30 points).
- Correct implementation of numerical methods (10 points).
- Correct analysis of results, including convergence, validation, and response assessment (50 points).

The report and supporting code should be submitted through “Assignments” in Brightspace. The due date is **Friday 14/06/2024 at 23:59.**