Effects of Breaking Waves on Offshore Wind Turbine Substructures
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1. Introduction
- Breaking waves occur when the wave base is no longer able to support its crest or when the wave height exceeds 0.8-1.2x higher than water depth.
- Loads from breaking waves are one important factor which needs to be added into consideration during designing process of substructures.[1]
- Modeling & analyzing breaking wave loads using CFD (Computational Fluid Dynamics) is one way to understand their effects on offshore wind turbine substructures.

2. Objectives
- Determine hydrodynamic effects of breaking waves on offshore wind turbine substructures
- Generate high fidelity CFD simulations of breaking waves.
- Validate CFD models of breaking waves and their loads against experimental data.

3. Methods
- Recreate offshore wind turbine substructures in CAD using Autodesk Inventor.
- Generate CFD simulations of interactions between breaking waves and substructures using the CFD software Converge.
- CFD uses knowledge of fluid physics, numerical analysis and computer science to model fluid without doing any experiments.
- Post-process CFD simulations using Ensight and collect data to draw conclusions.
- Post-processing using Ensight helps to visualize, analyze and communicate data about fluid flows.

4. Results
- Python script files for Ensight post-processing
- Helps to automate reoccurring tasks.
- Makes easy to do manipulations in post-processing.
- Easily recovers lost or crashed post-processing sessions.
- Saves time.
  - CAD models of 4-legs jacket substructures
  - OC4 jacket substructure for NREL 5MW wind turbine.[3]
  - Jacket substructure for DTU-10MW wind turbine. [4]

5. Future work
- Validate CFD simulations of breaking wave loads against experimental data.
- Use validated CFD simulation techniques to study breaking waves and their loads on monopile as well as jacket substructures.

References

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