Development, Verification and Validation of 3DFloat; Aero-Servo-Hydro-Elastic Computations of Offshore Structures.

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Abstract
The aero-servo-hydro-elastic Finite-Element-Method (FEM) code 3DFloat is tailored for nonlinear, full coupling time-domain simulations of offshore structures in general, and offshore wind turbines in particular. The verification and validation histories for offshore wind turbines include the IEA OC3/OC4/OC5 projects, two wave tank tests and participation in commercial projects. Current development examples include implementation of advanced hydrodynamics in the DIMESELO project, implementation of soil/structure interaction macro-elements in the REDWIN project, and optimization of large rotors with sweep in an industry project.

Advanced hydrodynamics in DIMESELO (www.dimselo.no)
The project partners IFE, DTU, NTNU Statoil and Statkraft, develop and implement advanced hydrodynamic models. Figure 2 compares the inline force for a bottom-fixed cylinder with diameter 6m at a water depth of 35m, subject to regular waves with wave height 16.6m and period 11.4s. The 3DFloat Morison and Rainey computations use stream function of order 12 for the kinematics. The Rainey and IFE in-house CFD results agree very well. The standard Morison model underpredicts the peak force by 15% compared to the Rainey and CFD results.

Figure 1: Comparison of inline force for a bottom-fixed cylinder

Figure 2 shows surge and heave motions for a 80 x 30 x 8m pontoon supported by springs, used in a conceptual design study of a Submerged Floating Tunnel. The sea state corresponds to an effective wave height of 0.5m, and a peak period of 14s in the JONSWAP spectrum. As a first check of the Linear Potential Theory implementation in 3DFloat, corresponding results from SIMO are shown in the same figure.

Conclusions and further work
• 3DFloat is a platform for:
  • Innovation and technical development
  • Research on computational methods

• IFE has allocated resources for helping industrial partners getting started with computations of their in-house designs.

• The next steps for upgrades include:
  • Linear Potential Theory distributed on elements
  • Bluff body aerodynamics

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References