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Efficient stochastic dynamic response analysis for design of offshore wind turbines

There is a significant potential for offshore wind energy. In deeper water it may be most cost effective to exploit this potential by using floating wind turbines. Some floating wind turbine concepts have already been proposed such as Hywind, Sway, WindFloat, WindSea, HiPRwind, DeepWind and so on.

Floating support structure has been approved and used by offshore oil industry for several decades. However, the combination of hydrodynamic load, aerodynamic load and wind turbine control, the non-linear coupling effect of flexible structure and mooring system and the requirement of saving cost significantly increase the complexity of the design work

As a result, it is very important to have a numerical tool that can well develop aero-hydro-servo-elastic model of floating wind turbine in time domain and enlighten the understanding of dynamic response behaviors.

Due to the complexity of the numerical model, it may be very time consuming to do numerical analysis, such as fatigue assessment, in time domain using a refined analysis tool. Consequently, the object of this research is to contribute some effort to find simplified method that can give simulation results in a short time with acceptable accuracy and can be used for design purpose in industry. Special emphasis of this research will be given to floating wind turbine with semi-submersible supporting structure and catenary mooring system. The refined model can be simplified in terms of aerodynamic loads, hydrodynamic loads, structural modeling for global response analysis, and so on.

There are many simplification methods that may be helpful to improve the efficiency of the design work. Careful research study, comparisons between the simplified methods and refined model and benchmark work are need before we can use these simplified methods.