Review – A fully integrated optimization framework for designing a complex geometry offshore wind turbine spar-type floating support structure

This work considers hull steel mass minimization for a spar floating wind turbine (FWT) using a genetic algorithm. The topic of FWT optimization is certainly of general interest, and the approach is interesting. There are, however, several important shortcomings in the present analysis. Some of these are discussed, but some additional analysis would greatly strengthen the presented results.

One of the main concerns relates to the estimation of the hydrodynamic loads on these generic hull forms. It is difficult to accept that the MacCamy-Fuchs formulation + Froude-Krylov forces in heave will give representative loads for these geometries with multiple horizontal surfaces. At the very least, the hydrodynamic characteristics of the optimized design should be studied in i.e. WAMIT or NEMOH, and a comparison of the performance should be given. This is discussed to some extent in section 6, but a re-analysis would provide much more information.

The approach for selecting the wall thickness in the present work may also be questioned. The steel mass per displaced volume is selected based on traditional spar designs, and yet applied to very different designs. At a minimum, hydrostatic pressure and the horizontal plates (top and bottom of the cylindrical sections) need to be considered. For the selected design, if I understand correctly, there are significant areas of the outer structure (which are subjected to hydrostatic and hydrodynamic pressures) which are simply accounted for by a very thin cap. This means that the optimizer will unrealistically reward designs with large diameter. In reality, such a design will require stiffeners and bulkheads (as well as expensive welding for the truss section which might replace the middle part of the column).

The mooring system assumptions are also confusing to me: are the fairlead locations maintained at z=-70m regardless of the draft of the design? This also has important consequences for the mean pitch motions.

Some additional information about the optimizer would also strengthen the present work. For example, how are the variables coded? What strategies are employed to introduce variation (mutation, immigration, others)? Could the performance be improved by “culling” the initial population so that (at a minimum) the geometric constraints which are cheap to compute are satisfied? It would be nice to distinguish between bounds and constraints in the optimization definition.

The introduction/text should be updated to account for the state of industry FWT farms (i.e. WindFloat Atlantic).

The paragraph beginning on line 35 is rather unwieldy and could be shortened – perhaps a table or other approach could be used to summarize the literature in a more efficient way? At a minimum, this paragraph should be separated into several shorter paragraphs.

I think it would make the reader’s life easier if table and figures referred to physical variable names (for example $D_{BC_{up}}$) rather than optimization variable names x_i, which are more difficult to remember.

In general, the paper would also benefit from an effort to shorten and simplify the sentences.