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Interactive comment on "Structural optimisation of wind turbine towers based on finite element analysis and genetic algorithm" *by* Lin Wang et al.

Anonymous Referee #1

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General comment:

The manuscript addresses sizing optimization of onshore wind turbine towers by combining finite element analyses performed in commercial software with genetic algorithm. Tower top diameter, tower bottom diameter, and thickness distributions are used as design variables in the minimization of mass, constrained by variable bounds, deformation constraints, ultimate stress constraints, fatigue constraints, buckling constraints, and vibration constraints.

The topic is worth investigating and important for further improving the design of wind turbine towers, and the topic is suited for Wind Energy Science. However, I do have some concerns about the modeling of the tower which are listed in the specific comments section.

The introduction is lacking a more thorough overview of structural optimization of wind turbine towers/support structures, which is the main aspect of the paper. It seems that mainly optimization using GA is listed, and these references appear in a later section (Section 3). Also, most references in the paper are to blade design rather than tower design.

Specific comments:

Line 64-65 The categorization of optimization algorithms is crude. E.g. gradient based algorithms are not mentioned at all throughout the paper although it has been widely applied in wind energy research.

Line 76-80 The authors mention that the genetic algorithm (GA) is capable of "avoiding being trapped in local optima" and that it is used to find "the optimal solution". This sounds like global optimum is guaranteed, which is not the case for many problems. This should be made clearer.

Line 144: The authors mention that the first 6 frequencies have been investigated, but only the first 4 are shown in the table. Additionally, the mesh is also used for stress analysis. Thus, mesh convergence should be performed on stresses too, as it is a much more local phenomenon that often requires much more fine mesh resolution than natural frequencies. Natural frequencies can often be obtained accurately with a coarse mesh.

Line 179: Why do the authors alter the height to 80 m, when the mesh convergence study was made on a tower of 87.6 m?

Line 190: Perhaps figure 3 and 4 can be combined, as figure 4 also contains the geometry of the turbine tower.

Line 195-228: It is very unclear which of the formulae in section 2.3.3.1 that is applied, as it seems loads are taken directly from Lanier (2005).

Eq (1) & (2): The 50-year wind velocity, the thrust coefficient, and the rotor radius are

defined, but no values seems to be given.

Line 240-242: The authors mention that the thrust force F and bending moment My are the most significant components. This should be clarified why. Also, no coordinate system has been defined, thus My is actually not defined.

Line 245: Damage Equivalent Loads are used for fatigue damage estimation. The authors should comment on the assumptions made in the DEL method.

Line 246: The authors write that the loads from Lanier (2005) are unfactored. However, in table J-6 in Lanier (2005) both the factored and un-factored values appear. Consequently, Table 5 can be reduced.

Line 251+253: The authors refer to Lanier (2005) for both the ultimate limit loads and fatigue loads. These loads are for a hub height of 100 m, and seems to be applied directly (without any comments on this) to a tower of 80 m. This should be explained.

Line 376->: Sudden changes in geometries (thicknesses) from segment to segment will give rise to large stress concentrations,. The authors should indicate (and comment on) if the stress concentrations are taken into account or not.

Line 415->: The authors should indicate the type of buckling analysis (linear/non-linear?)

Technical comments:

Line 60 fedility -> fidelity

Line 151: force-aft -> fore-aft

Line 160: force-aft -> fore-aft

Line 240: extreme 50-year extreme wind condition -> 50-year extreme wind condition

Line 283: There seems to be a mistake in the reference listing, “Lin et. al (Wang et al.,2016) . . .”

Line 572: Allable -> allowable

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