Wind turbine performance predictions using propeller vortex lattice methods[1] BRENDEN EPPS, MIT, RICHARD KIMBALL, Maine Maratime Academy — A major concern in the design and operation of large wind turbines is unsteady blade loads. These can lead to fatigue failure, and hence are a major structural design driver. Prediction and mitigation of peak blade loads is challenging, because the aerodynamic, structural, and controls problems are coupled, often non-linearly. An efficient computational tool is vital to analyze these types of problems early in the design cycle, before structural designs are frozen and full-blown CFD and FEA are performed. The authors present a computational tool for the design and analysis of large wind turbines. The numerical model is based on the propeller vortex lattice lifting line methods utilized by the US Navy as well as commercial propeller designers. The numerical model is implemented in an open-source code suite called OpenProp, which includes turbine optimization routines as well as performance analysis routines. Examples of turbine designs are presented, including actual parts and experimental performance data.

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