

Software Development for Both Small Wind Performance Optimization and Structural Compliance Analysis with International Safety Regulations

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Abstract : Conventional commercial wind turbine design software is limited to large wind turbines due to not incorporating with low Reynold's Number aerodynamic characteristics typically for small wind turbines. To extract maximum annual energy product from an intermediately designed small wind turbine associated with measured wind data, numerous simulation is highly recommended to have a best fitting planform design with proper airfoil configuration. Since depending upon wind distribution with average wind speed, an optimal wind turbine planform design changes accordingly. It is theoretically not difficult, though, it is very inconveniently time-consuming design procedure to finalize conceptual layout of a desired small wind turbine. Thus, to help simulations easier and faster, a GUI software is developed to conveniently iterate and change airfoil types, wind data, and geometric blade data as well. With magnetic generator torque curve, peak power tracking simulation is also available to better match with the magnetic generator. Small wind turbine often lacks starting torque due to blade optimization. Thus this simulation is also embedded along with yaw design. This software provides various blade cross section details at user's design convenience such as skin thickness control with fiber direction option, spar shape, and their material properties. Since small wind turbine is under international safety regulations with fatigue damage during normal operations and safety load analyses with ultimate excessive loads, load analyses are provided with each category mandated in the safety regulations.

Keywords : GUI software, Low Reynold's number aerodynamics, peak power tracking, safety regulations, wind turbine performance optimization

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