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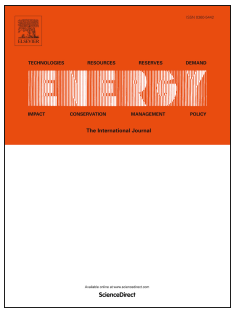

Aeroacoustic and aerodynamic optimization of a MW class HAWT using MOPSO algorithm

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Aeroacoustic and Aerodynamic Optimization of a MW class HAWT using MOPSO Algorithm

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Abstract

In this paper, results of WindPACT 1.5 MW baseline horizontal axes wind turbine aeroacoustic and aerodynamic optimization are presented. For this purpose, the blade twist, the chord distribution, the airfoils for all sections, and the rotational speed are optimized with Multi-Objective Particle Swarm Optimization (MOPSO) algorithm. The geometric 'Class/Shape function' transformation technique and Bézier curve are used for geometry parameterization. Improved blade element momentum theory and Brooks, Pope and Marcolini semi-empirical methods are implemented for wind turbine power and aeroacoustic noise calculation in the optimization procedure. MOPSO parametric study is conducted to increase both robustness and speed of the optimization cycle. Optimization objective functions are power output and Overall Average Sound Pressure Level. After optimization, Improved delayed detached eddy simulation is employed to verify the new wind turbine output power and noise sources. The noise propagation to the far field is calculated with the Ffowcs Williams and Hawkings acoustic analogy. Results show about 1dB noise reduction as well as 6% power increment for the optimized WindPACT wind turbine.

Keywords: Aeroacoustic; Aerodynamic; Horizontal axis wind turbine; Multi-objective particle swarm optimization

Nomenclature

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