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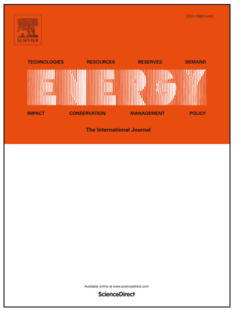

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Wind Turbine Blade Geometry Design Based on Multi-objective Optimization Using Metaheuristics

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Abstract

The application of evolutionary algorithms to wind turbine blade design can be interesting, by reducing the number of aerodynamic-to-structural design loops in the conventional design process, hence reducing the design time and cost. Recent developments showed satisfactory results with this approach, mostly combining genetic algorithms with the blade element momentum theory. The general objective of the present work is to define and evaluate a design methodology for the rotor blade geometry in order to maximize the energy production of wind turbines and minimize the mass of the blade itself, using for that purpose stochastic multi-objective optimization methods. An optimization benchmark problem was proposed, which represents the wind conditions and present wind turbine concepts found in Brazil. A variable speed pitch-controlled 2.5 MW direct-drive synchronous generator turbine with a rotor diameter of 120 m was chosen as concept. Four different multi-objective evolutionary algorithms were selected for evaluation in solving this benchmark problem: Non-dominated Sorting Genetic Algorithm version II (NSGA-II), Quantum-inspired Multi-objective Evolutionary Algorithm (QMEA), Multi-objective Evolutionary Algorithm Based on Decomposition (MOEA/D), and Multi-objective Optimization Differential Evolution Algorithm (MODE). Detailed analysis of the best

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