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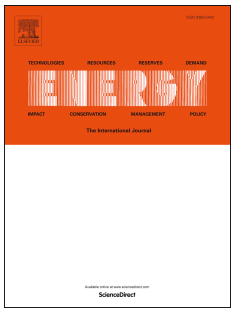

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Aerodynamic Design of Horizontal Axis Wind Turbine with Innovative Local Linearization of Chord and Twist Distributions

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Abstract

This study is aimed to aerodynamically design a 1 mega-Watt horizontal axis wind turbine in order to obtain the maximum power coefficient by linearizing the chord and twist distributions. A new linearization method has been used for chord and twist distributions by crossing tangent line through different points on them. The results have determined the best point along chord and twist distribution which has higher total power coefficient in the linearization method. When the distribution of chord length and twist angle is linear, blade manufacturing becomes more accurate and easier. Since the geometry of the blades determines the power generated by rotor, designing the blade is a very important issue. Herein, calculations are done for different types of airfoil families namely Risø-A1-21, Risø-A1-18, S809, S814 and Du 93-W-210. Hence, the effect of selecting different airfoil families is also indicated. Lift and drag coefficients of the selected airfoils have been extracted from airfoil catalogue which are determined by XFOIL. Optimum linearized chord and twist distribution by considering total power coefficient as optimization criterion is determined and observed that 60% to 64% and 30% to 37% of the blade span-wise are the best places for optimum linearization of chord and twist, respectively.

Keywords: Horizontal Axis Wind Turbine; Aerodynamic Design; Blade Element Momentum (BEM) Theory; Blade Shape; Linearization; Power Coefficient.