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IMPROVING THE AERODYNAMIC EFFICIENCY OF WIND GENERATORS

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Annotation: Wind power is one of the fastest-growing renewable energy sectors, but its overall performance depends heavily on aerodynamic design. This paper discusses methods to enhance the aerodynamic efficiency of wind turbines through blade optimization, active flow control, and adaptive pitch regulation systems.

Keywords: Wind energy, aerodynamics, blade design, turbulence, efficiency improvement

Main Text

Aerodynamic optimization is fundamental to maximizing the energy conversion efficiency of wind generators. Blade geometry significantly influences power output, as small changes in chord length or twist angle can lead to substantial improvements in lift-to-drag ratio. Modern computational fluid dynamics (CFD) simulations enable precise modeling of turbulent airflow, leading to optimized airfoil profiles for varying wind speeds.

Active flow control using microflaps and morphing blades has emerged as a promising solution to mitigate aerodynamic losses during gusts. Additionally, adaptive pitch regulation systems dynamically adjust blade angles to maintain optimal aerodynamic performance across different operational conditions. Materials such as carbon fiber composites further improve turbine reliability and reduce fatigue stress.

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