Patent Search

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Abstract:

The invention pertains to a wind turbine blade design leveraging aeroelastic tailoring principles. By strategically manipulating material properties and layup configura blade achieves optimized aerodynamic performance while ensuring structural resilience. This design is adaptable to advanced manufacturing techniques and can int sensor systems, providing real-time feedback on performance metrics. The result is a blade that promises enhanced energy capture, prolonged operational lifespan, potential reduction in maintenance costs, marking a significant advancement in wind energy technology.

Complete Specification

Description:The present invention relates generally to the design and optimization of wind turbine blades. More specifically, the invention pertains to an efficient wi turbine blade design that incorporates aeroelastic tailoring techniques to enhance aerodynamic performance, structural integrity, and energy capture, while potent reducing weight and manufacturing costs.

Background of the invention:

Wind energy, as one of the most promising renewable energy sources, has witnessed significant advancements over the past few decades. The push for cleaner anc sustainable energy solutions has accelerated research and development in the wind energy sector, emphasizing the design and efficiency of wind turbines. Central performance of a wind turbine is the design of its blades, which are responsible for capturing wind energy and converting it into rotational mechanical energy. Trad blade designs have primarily focused on aerodynamic shapes to maximize energy capture, often derived from airfoil data and wind tunnel testing.

However, as turbines have grown in size to capture more energy, especially in the case of offshore wind farms where turbines can have a rotor diameter exceeding meters, the dynamic behavior of these blades under varying wind loads has become a significant concern. Large blades are more flexible and can undergo consider deflections, leading to a phenomenon known as aeroelastic flutter, which can cause premature structural failure. Additionally, the interaction between aerodynamic and the structural response of the blade, termed aeroelasticity, has shown that simple scaling of smaller blade designs may not yield the most efficient or durable c for larger blades.

The need for a blade design that addresses both aerodynamic and structural concerns is evident. While many traditional designs have focused on either stiffening t blade, adding dampers, or adjusting the rotational speed of the turbine to avoid critical operational conditions, these solutions often come with trade-offs in terms

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