

Maximizing the Aerodynamic Performance of Wind and Water Turbines by Utilizing Advanced Flow Control Techniques

Authors : Edwin Javier Cortes, Surupa Shaw

Abstract : In recent years, there has been a growing emphasis on enhancing the efficiency and performance of wind and water turbines to meet the increasing demand for sustainable energy sources. One promising approach is the utilization of advanced flow control techniques to optimize aerodynamic performance. This paper explores the application of advanced flow control techniques in both wind and water turbines, aiming to maximize their efficiency and output. By manipulating the flow of air or water around the turbine blades, these techniques offer the potential to improve energy capture, reduce drag, and minimize turbulence-induced losses. The paper will review various flow control strategies, including passive and active techniques such as vortex generators, boundary layer suction, and plasma actuators. It will examine their effectiveness in optimizing turbine performance under different operating conditions and environmental factors. Furthermore, the paper will discuss the challenges and opportunities associated with implementing these techniques in practical turbine designs. It will consider factors such as cost-effectiveness, reliability, and scalability, as well as the potential impact on overall turbine efficiency and lifecycle. Through a comprehensive analysis of existing research and case studies, this paper aims to provide insights into the potential benefits and limitations of advanced flow control techniques for wind and water turbines. It will also highlight areas for future research and development, with the ultimate goal of advancing the state-of-the-art in turbine technology and accelerating the transition towards a more sustainable energy future.

Keywords : flow control, efficiency, passive control, active control

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