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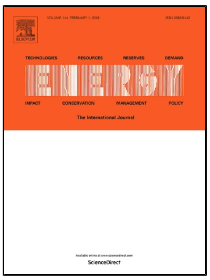

Active load control of large wind turbines using state-space methods and disturbance accommodating control

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Abstract

The control of wind turbine loads is fundamental to reduce wind energy cost. Wind turbines are complex dynamic systems subjected to random wind loads and harsh operational vibrations. Active load control reduces wind turbine mechanical vibrations, provoking an increase in wind turbine components lifetimes and the design of lighter and more flexible parts, reducing wind turbine global cost. The pitch control system plays a decisive role in shaping the wind turbine dynamics. By using the appropriate control methods, it can be used to reduce the dynamic response in most of wind turbine components, given the fully-coupled system dynamics. In this paper, it is demonstrated the development of an active load control of the wind turbine tower loads using the pitch control system. State-space control is carried out to consider the coupled wind turbine dynamics and the disturbance accommodating control (DAC) is used to cancel the effect of wind disturbances in the dynamics of the overall system. The active load control is performed without damaging the aerodynamic power control.

Keywords: active load control, wind turbines, pitch control, structural dynamics, aeroelastic simulation.

1. Introduction

In the last decades, concerns about environmental problems and global warming have motivated the development of renewable energy sources. The wind energy is currently the most widespread of these, with the global installed capacity reaching 487 GW by the end of 2016 [1]. It also has a cost of energy which is the most competitive amongst the renewable sources compared to the conventional ones, and consequently it is the most viable renewable energy source [2,3]. This happens because the technology of designing and siting wind turbines is well-established. On the other hand, continuously improving of wind energy competitiveness by reducing its cost is a fundamental task. Some technical innovations are still necessary to allow further reduction in the cost of energy. Reducing