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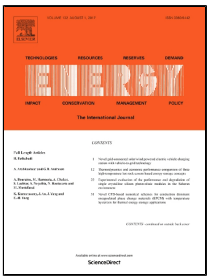

A novel wind speed estimator-integrated pitch control method for wind turbines with global-power regulation

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A novel wind speed estimator-integrated pitch control method for wind turbines with global-power regulation

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ABSTRACT

The increasing penetration of wind power has led to a growing interest in that wind turbines (WTs) are operated with global-power regulation, which refers to de-rating and rated power regulation. In this study, the conventional control method is introduced and analyzed. The analysis results show that the conventional control methods may not provide sufficient performance when the WTs are operated along different operating trajectories during the global-power regulation. Accordingly, this study proposes a novel pitch control method that integrates a non-standard extended Kalman filter-based estimator. In this method, a cascade control structure is developed for the pitch controller, which receives the speed reference from a power-speed scheduler. To improve the cascade controller design, the nonlinearities in the WT should be removed by utilizing the information provided by the estimator. By doing so, the proposed controller provides a consistent optimal performance under the global-power regulation while avoiding wind measurement. Finally, the proposed method is validated on a real industrial 1.5MW WT. The comparative experimental results demonstrate the significant improvements made using the proposed method in maintaining the speed and pitch-actuator usage for global-power regulation of the WTs compared to the conventional method.

KEYWORDS

Variable speed wind turbines; global-power regulation; pitch control; extended Kalman filter; wind estimation.

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