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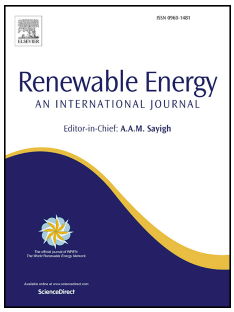

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Fault-tolerant wind turbine pitch control using adaptive sliding mode estimation

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Abstract

Wind turbine pitch systems are essential for actuating desired blade angles and hence to keep the generator at rated speed in operation region 3. In the presence of parametric pitch actuator faults, pitch systems may have slow dynamics, affecting the pitching performance with the possibility of oscillation on the generator speed and making the turbine system unstable and unsafe. This work proposes a strategy for compensating the pitch actuator faults to recover the nominal pitch dynamics. The proposed fault-tolerant control (FTC) scheme incorporates a traditional Proportional-Integral (PI) controller as baseline system to achieve nominal pitch performance, along with a fault compensator to eliminate the actuator fault effects. The approach is based on estimation of the pitch system states and fault indicator function using an adaptive step-by-step sliding mode observer, effectively handling the nonlinear fault distribution function with a simple design. The effectiveness of the design strategy is verified using a 4.8 MW benchmark wind turbine system.

Keywords: Wind turbine pitch actuation, parametric actuator faults, fault estimation, fault-tolerant control, sliding mode observer

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