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Design and real time implementation of sliding mode supervised fractionalcontroller for wind energy conversion system under sever working conditions

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Abstract: Wind energy conversion system (WECS) is increasingly taking the place to be the most promised renewablesource of energy, which obliges researchers to look for e?ective control with low cost. Thus, this paper proposesto build a suitable controller for speed control loop to reach the maximum power point of the wind turbine undersever conditions and to ensure the stability of the outer voltage regulation loop to meet high range of loadvariations. In literature, a major defect of the well-used conventional PI controller is the slow response time andthe high damping. Nowadays, intelligent controllers have been used to solve the drawbacks of the conventionalones but they demand high speed calculators and expensive cost. Moreover, many solutions proposed thefractional order PI controller (FO-PI) by extending the order of integration from integer to real order. The FO-PIcontroller presents also some weakness in steady state caused by the approximation methods. The idea of thispaper is to propose a Sliding Mode Supervised Fractional order controller (SMSF) which consists of conventionalPI controller, FO-PI controller and sliding mode supervisor (SMS) that employs one of the controllers to ensuregood steady and transient states. WECS laboratory prototype is built around real-time dSPACE cards andevaluated to verify the validity of the developed SMSF. The results clearly ful?ll the requirements, con?rm itshigh performance in steady and transient states and demonstrate its feasibility and e?ectiveness.

Keywords : Maximum Power Point Tracking (MPPT), Wind Energy Conversion System (WECS), PI controller, Fractional order PI controller, Sliding mode control, Direct power control