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Type-2 Fuzzy Logic Predictive Control of a Grid Connected Wind Power Systems with Integrated Active Power Filter Capabilities

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Abstract: This paper proposes a real-time implementation of an optimal operation of a double stage grid connected wind power system incorporating an active power filter (APF). The system is used to supply the nonlinear loads with harmonics and reactive power compensation. On the generator side, a new adaptive neuro fuzzy inference system (ANFIS) based maximum power point tracking (MPPT) control is proposed to track the maximum wind power point regardless of wind speed fluctuations. Whereas on the grid side, a modified predictive current control (PCC) algorithm is used to control the APF, and allow to ensure both compensating harmonic currents and injecting the generated power into the grid. Also a type 2 fuzzy logic controller is used to control the DC-link capacitor in order to improve the dynamic response of the APF, and to ensure a well-smoothed DC-Link capacitor voltage. The gained benefits from these proposed control algorithms are the main contribution in this work. The proposed control scheme is implemented on a small-scale wind energy conversion system (WECS) controlled by a dSPACE 1104 card. Experimental results show that the proposed T2FLC maintains the DC-Link capacitor voltage within the limit for injecting the power into the grid. In addition, the PCC of the APF guarantees a flexible settlement of real power exchanges from the WECS to the grid with a high power factor operation.

Keywords : Active power filter (APF), Adaptive neuro fuzzy inference system (ANFIS), Maximum Power Point Tracking (MPPT), Predictive current control (PCC), Type-2 fuzzy logic controller (T2FLC)