Enhanced Direct Power Control of DFIGs driven by Wind Turbine under Unbalanced Grid Voltage

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March 20, 2023

Abstract

Undesired oscillation components appear in active and reactive powers, electromagnetic torque and DC-link voltage of doubly fed induction generators (DFIGs) connected to unbalanced grid voltage. These components oscillate at double source frequency as a result of negative sequence components in voltage and current. Different direct power control (DPC) techniques were studied in literatures to damp these oscillations. However, these techniques require sequence decomposition process, axes transformation of stator voltage/current and estimation of different power components which complicate the overall control system. This paper presents a simplified DPC of DFIGs in stationary reference frame under normal and unbalanced grid voltage. Decomposition process, axes transformation and compensation power terms are totally eliminated. Vector proportional- integral (VPI) controllers are designed to regulate stator active and reactive powers. The performance of the proposed DPC scheme using VPI and proportional-integral-resonant (PIR) controllers is analyzed and compared under different operating conditions. Bode diagram of open loop and closed loop control using VPI and PIR are studied to illustrate stability, steady state and transient response of the two controllers. Also, the performance of proposed technique and previous DPCs designed in synchronous reference frame is compared to prove the validity of proposed one. The results show that proposed DPC using VPI has superior performance in steady state and transient conditions with simple implementation.

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