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A Systematic Approach via IIR Filters for Enhancing the Robustness of LCL-Type Shunt Active Power Filters to Grid Impedance

In this project, a Dual-Loop Current Control method (grid current loop and inverter-side current loop) is proposed for digitally controlled LCL-type Shunt Active Power Filters (APFs), due to its inherent active damping effect for LCL resonance. However, the damping region is only up to one sixth of the sampling frequency (fs/6), which leads to a limited system robustness against grid impedance variation at the Point of Common Coupling (PCC). Hence, in this study, the robustness of such control is discussed through mathematic derivations and diagram analysis, which reveals that both the system delays and PCC voltage feed forward affect the system robustness. On the basis of theoretical analysis, a systematic approach Via Infinite Impulse Response (IIR) filters has been proposed for enhancing the robustness to grid impedance. Thereof, a second-order IIR filter-based inverter-side current feedback is proposed to widen the damping region up to almost the Nyquist frequency (fs/2), while a band-stop IIR filter based PCC voltage feed forward is proposed to achieve the superior stability margins under a large grid impedance in comparison with unit feed forward. The performance of the proposed method evaluated the results using Matlab/Simulink software.

Domain: Power Systems _ Hybrid Systems
Technology: Electrical