Real-Time Low Voltage Ride Through Capability Improvement of PMSG-Wind Turbine Based on Robust Fractional Order Sliding Mode Control

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November 2, 2023

Abstract

In this article, a fractional-order sliding mode control (FOSMC) method is presented for a wind energy conversion system (WECS) with variable-speed direct-drive permanent magnet synchronous generator (PMSG) under both normal and fault conditions. Under normal operation of the system, the machine side converter (MSC) is employed to meet maximum power point tracking (MPPT) requirements of the wind turbine and the grid side converter (GSC) controls the DC-link voltage and the injected reactive. Under fault condition, to meet grid code obligations, such as low voltage ride through (LVRT), the MSC adjusts the DC-link voltage instead of the GSC. Meanwhile, the active and reactive powers are controlled by the GSC. Moreover, the suggested control method is compared to the conventional control system. The results depicted that the proposed control approach has better faster dynamic response and robustness under both balanced and unbalanced condition. In addition, improving LVRT capability and injecting reactive power, the suggested control method results in smaller spikes in the injected current and DC link voltage. For the sake of further validation, simulations are run in offline MATLAB/Simulink simulation. Then, the results have been validated via experimental real-time implementation.

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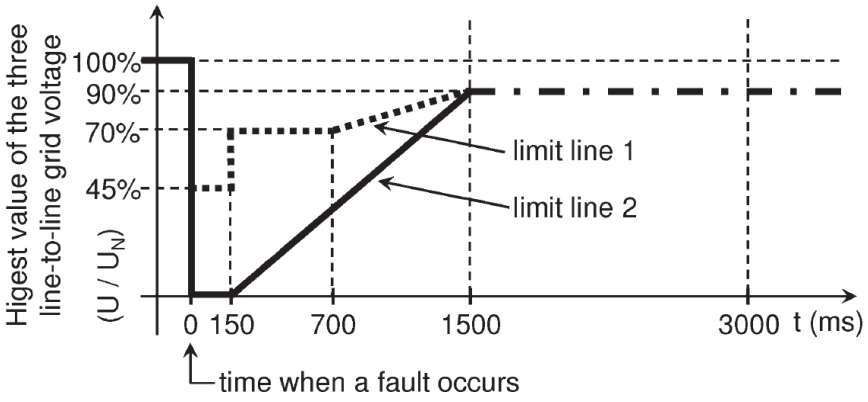

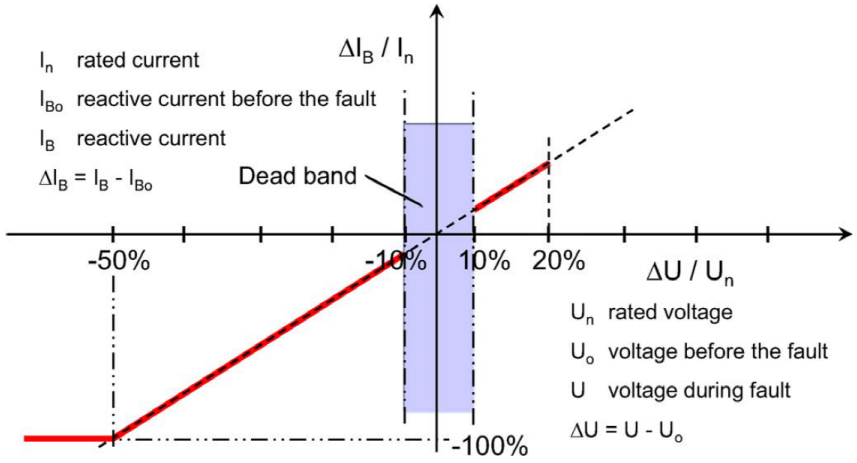

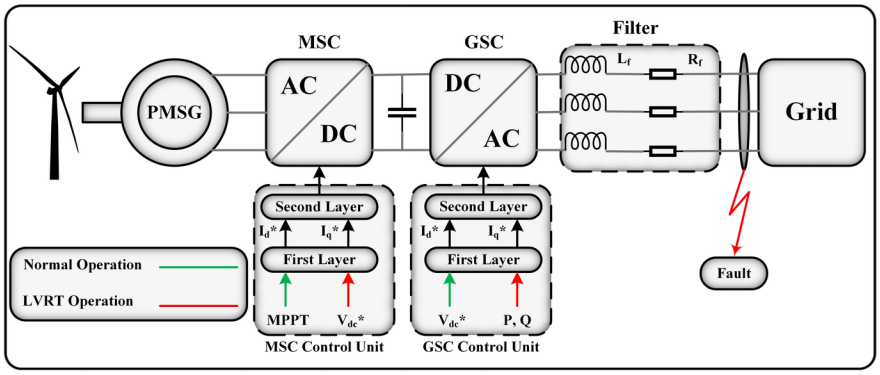

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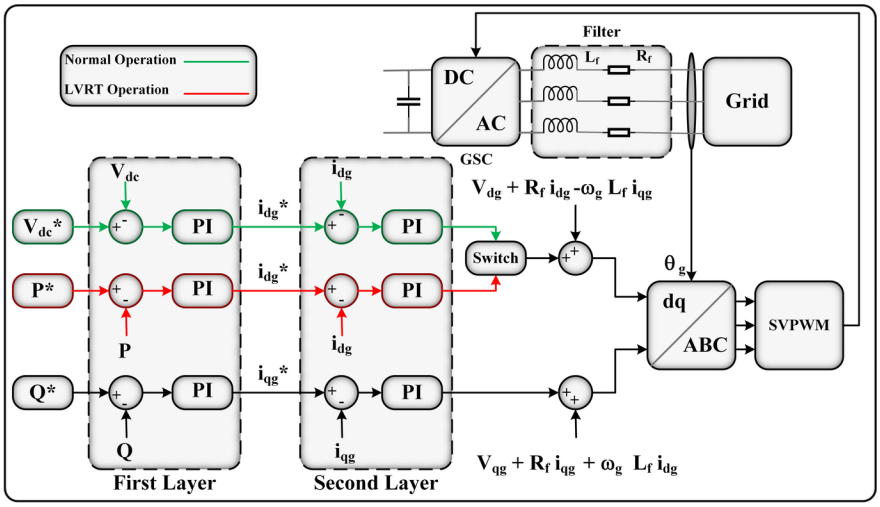

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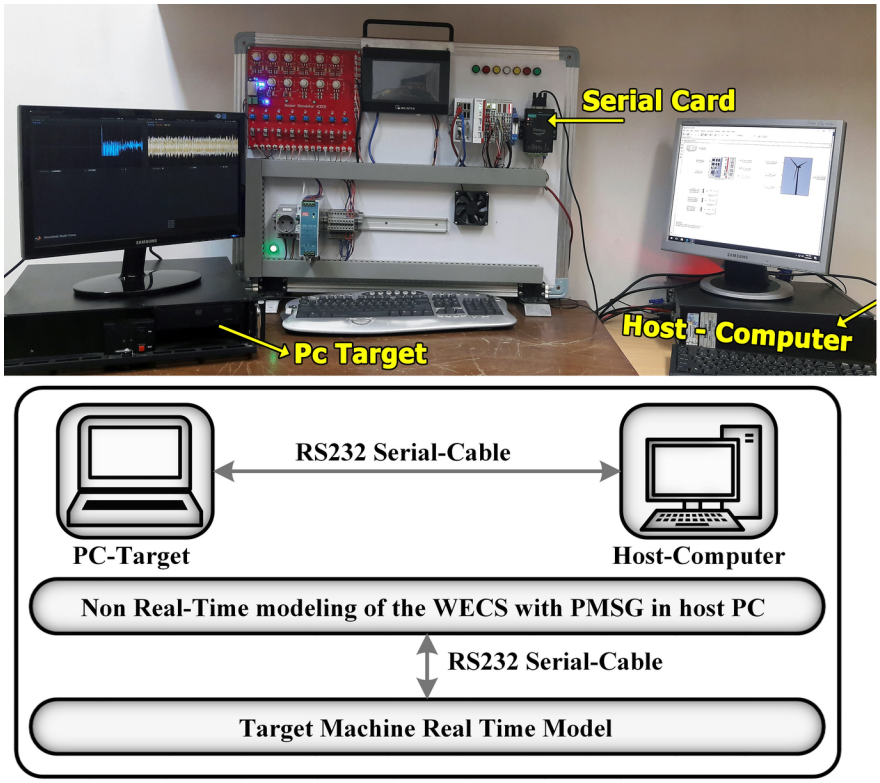

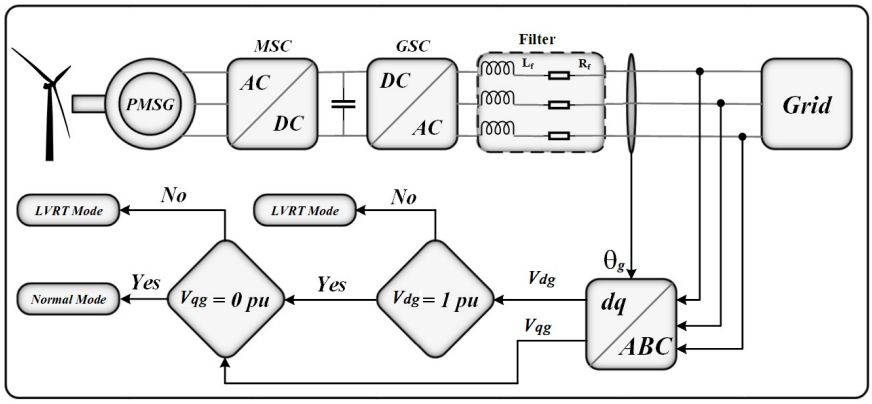

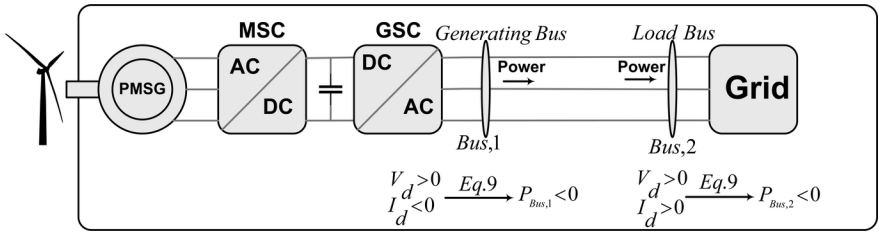

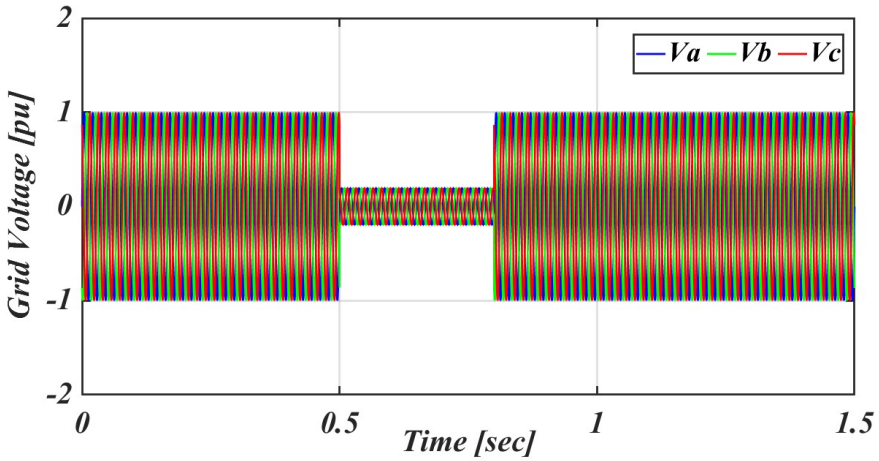

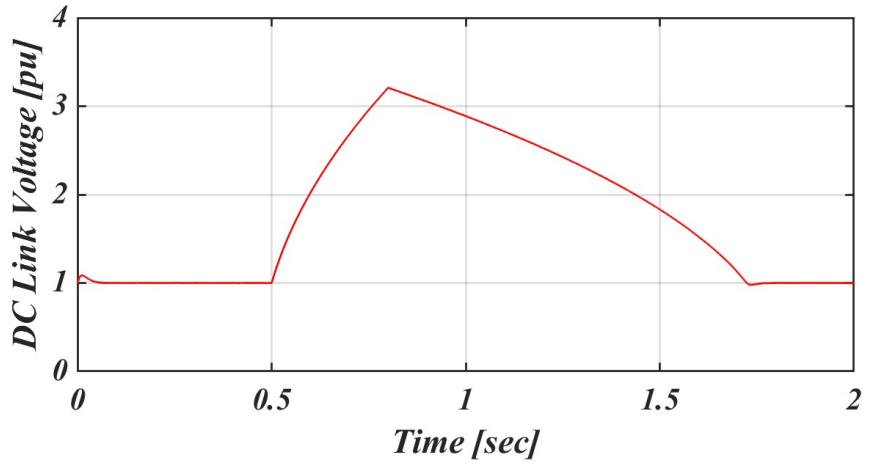

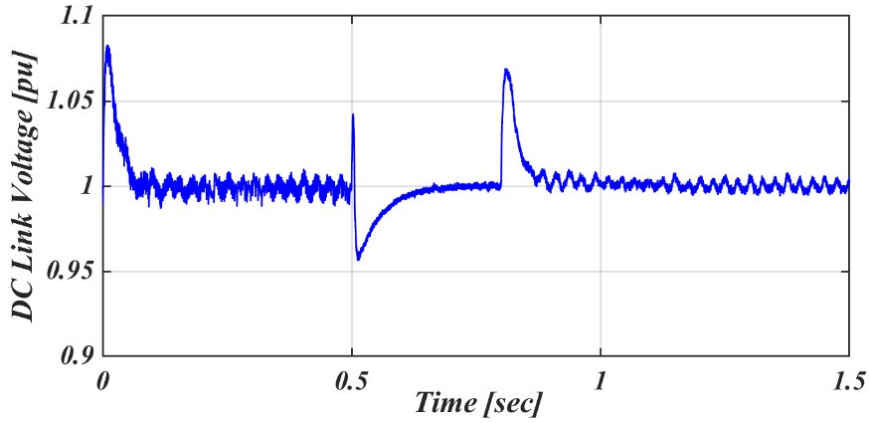

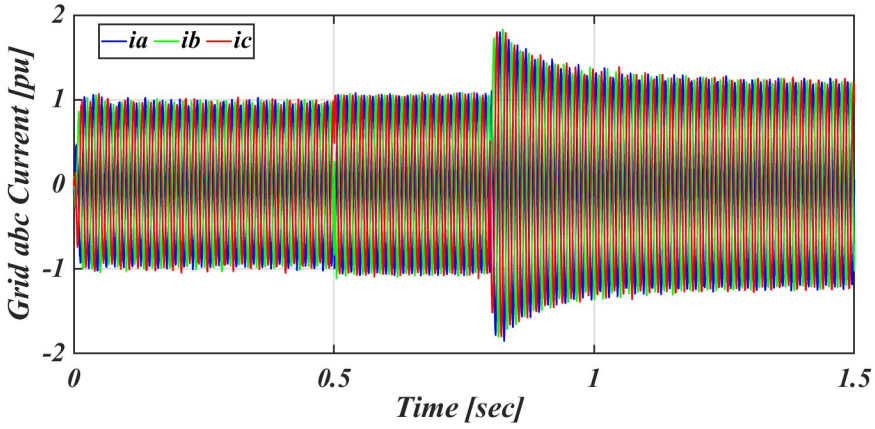

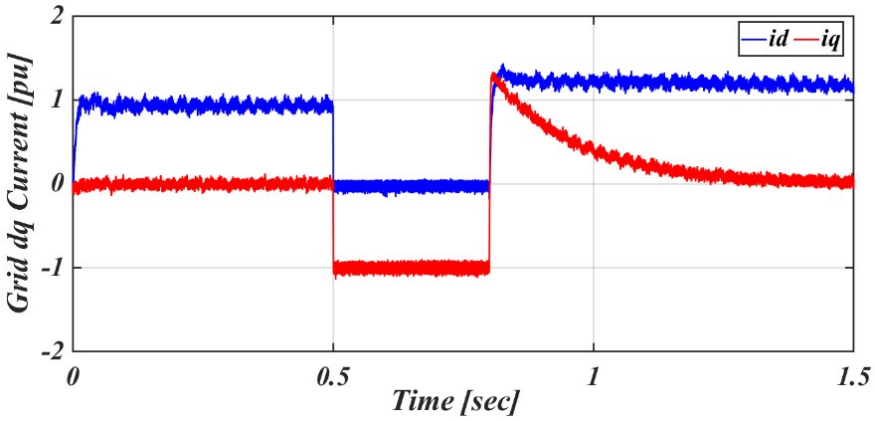

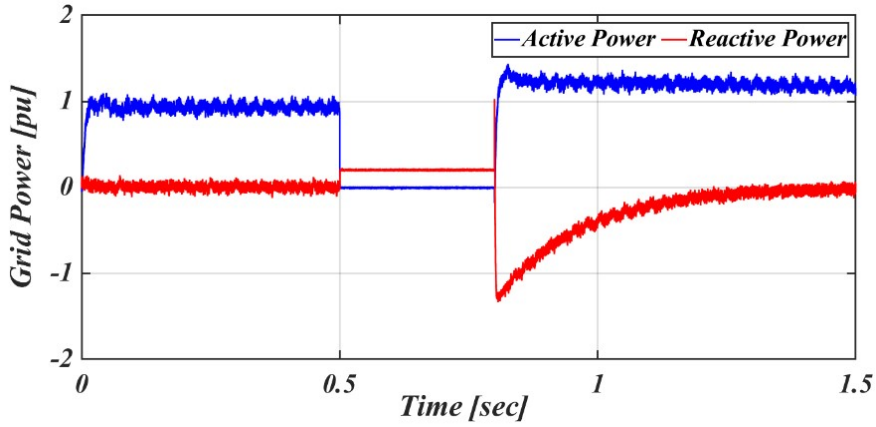

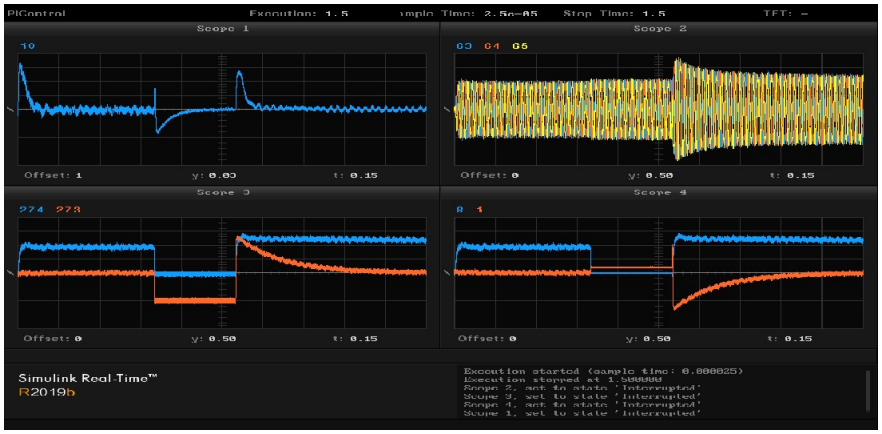

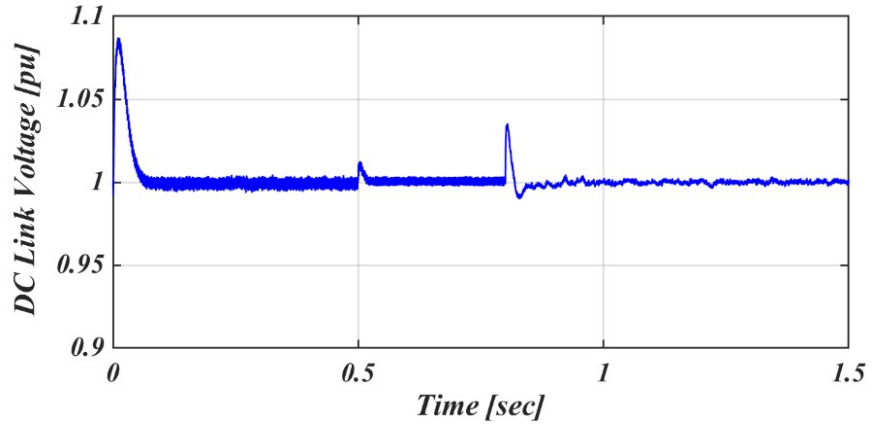

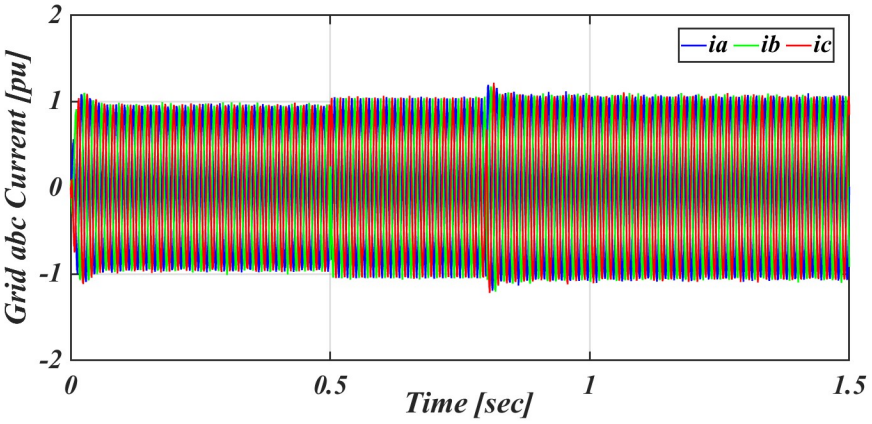

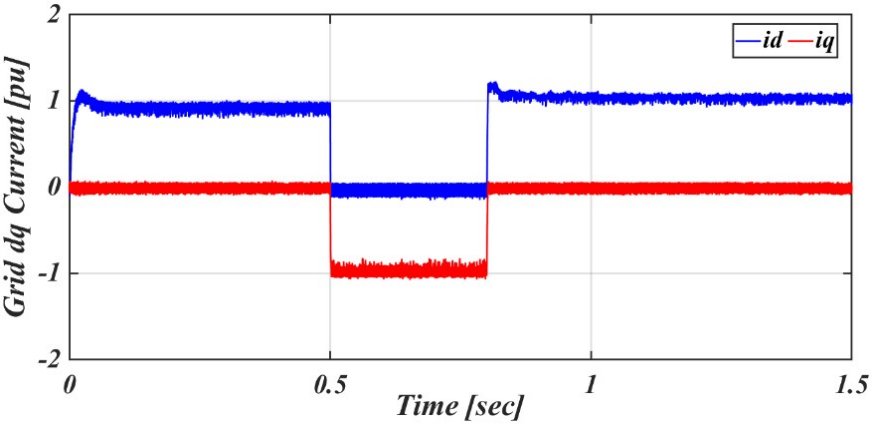

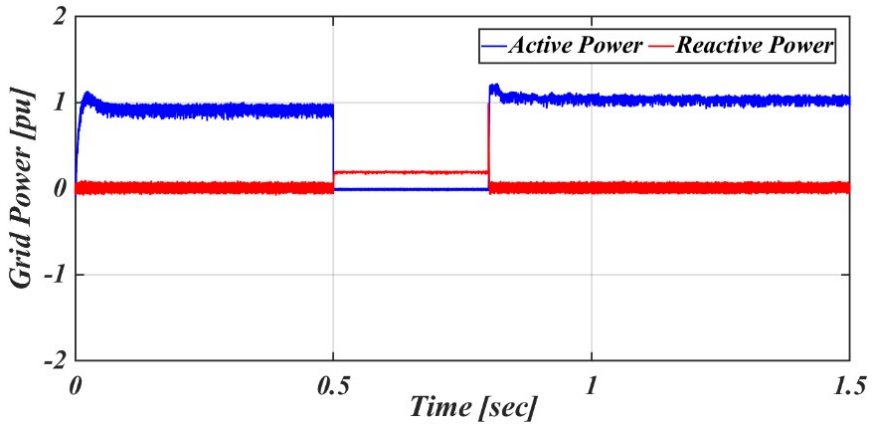

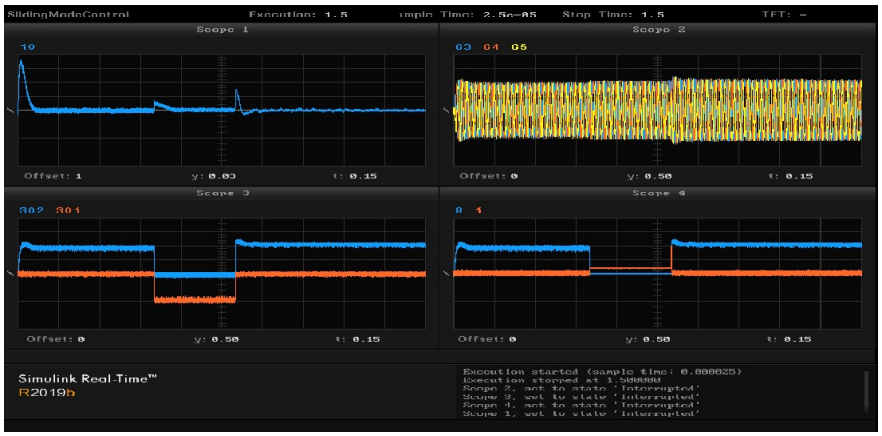

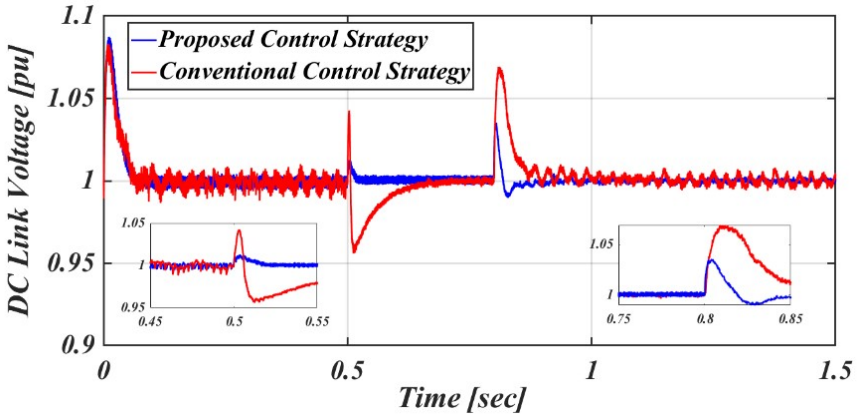

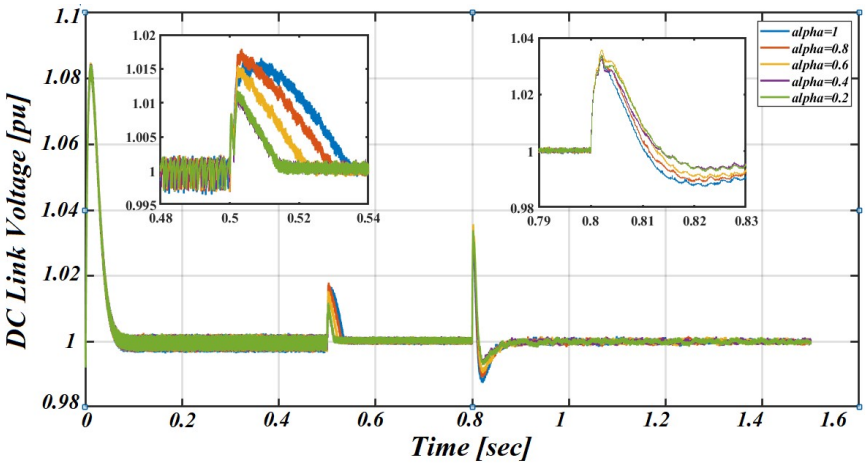

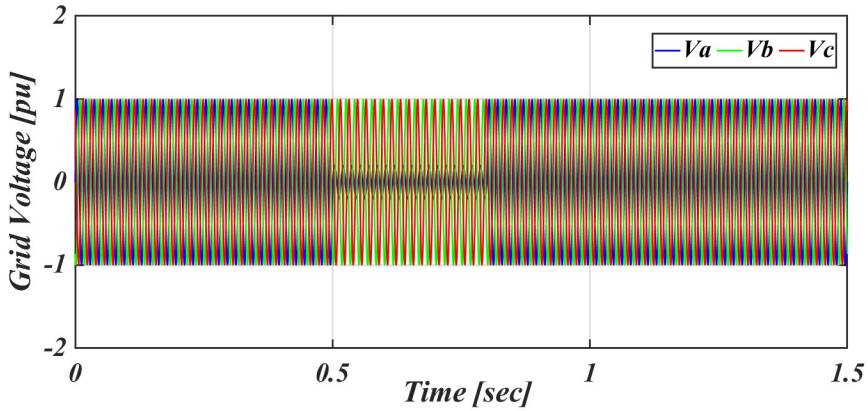

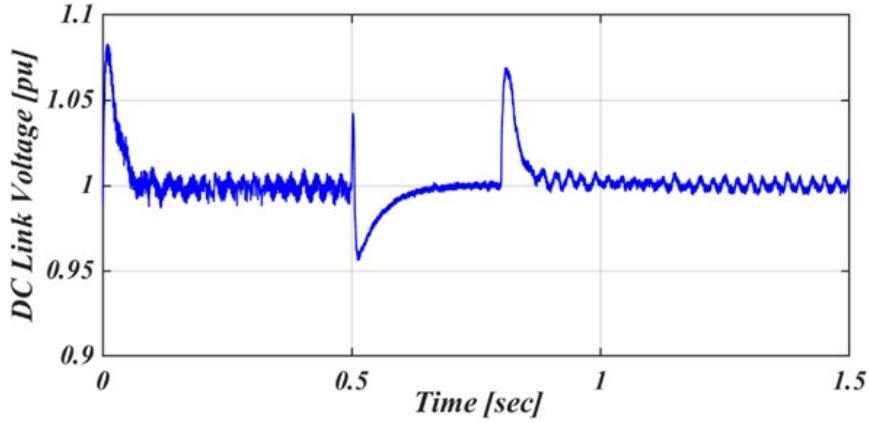

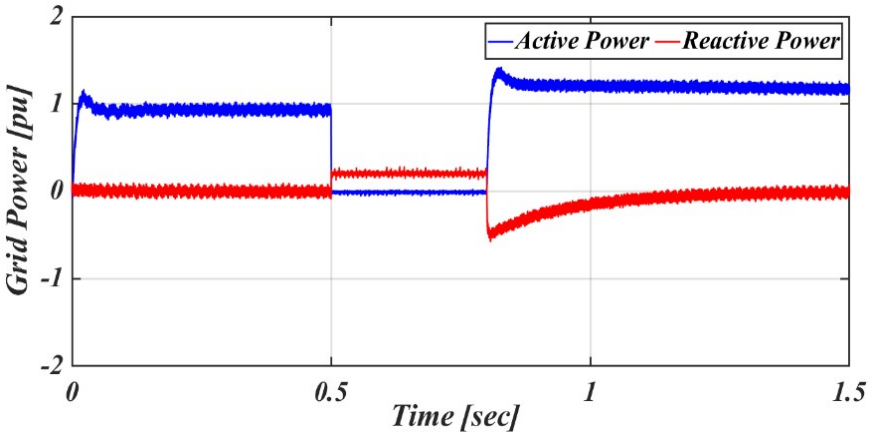

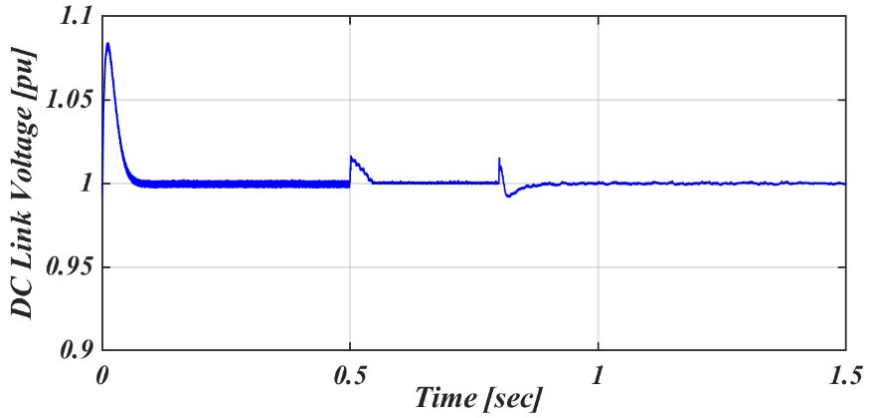

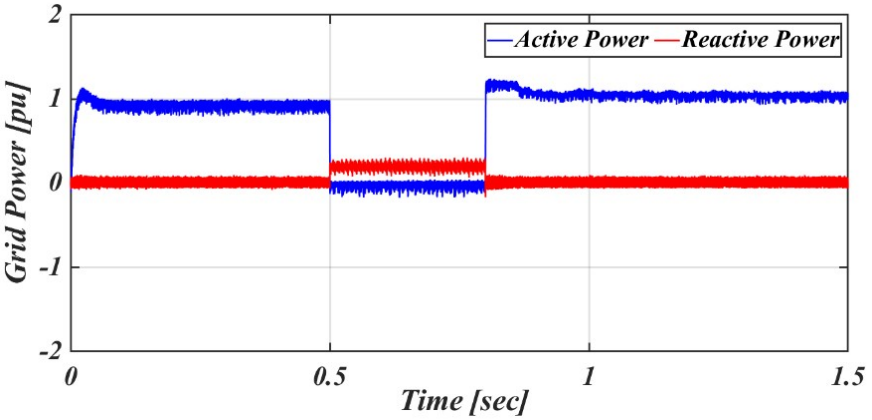

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