

Impact on transient stability of self-synchronisation control strategies in grid-forming power converters

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Abstract-

Grid-forming voltage source converters (GFM-VSCs) are emerging as a solution for integrating renewable energy resources (RERs) into power systems. GFM-VSCs need a self-synchronisation strategy to ensure that all converters and generators in the power system are in synchronism and they reach the same frequency in steady state. The self-synchronisation strategy in GFM-VSC that has received most attention in previous research is virtual synchronous machine (VSM) control. However, there has to date been no systematic study of the effects on transient stability of different variants of this strategy. This paper analyses and compares transient stability of four self-synchronisation strategies for GFM-VSCs: VSM without phase-locked loop (PLL), VSM with PLL, VSM without PLL using wash-out filter and integral-proportional (IP) controller. The paper also analyses two different methods that can be applied to GFM-VSC self-synchronisation strategies to improve transient stability: the concept of virtual unsaturated active-power controller (VAPC), proposed in previous work, and an algorithm for frequency limitation in the GFM-VSCs, which is proposed in this paper.

Index Terms- Voltage source converter; VSC; Grid forming; Transient stability; Frequency limiter controller

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