

Transient Stability of Power Synchronization Loop Based Grid Forming Converter

Yujun Li¹, Yiyuan Lu¹, Jialun Yang², Xiaotian Yuan¹, Rui Yang¹, Songhao Yang¹, Hua Ye², Zhengchun Du¹

¹Xi'an Jiaotong University, ²Shandong University

Abstract—Previous studies regard that the grid-forming (GFM) converter switches from the constant voltage control (CVC) to the current limiting control (CLC) at the point of intersection of the unsaturated and saturated power-angle curves, which might not be held in most situations. This article firstly derives the switching rule of GFM converter between two controls from the current limiting inequality. Accordingly, the conventional algebraic variable switched model is transferred to the proposed state variable switched model. Based on Lyapunov Theory, the stability of equilibrium points (EPs) is studied and the stable regions under two controls are further derived. In addition, one necessary stabilizing condition for the power synchronization loop based GFM (PSL-GFM) converter being locked in CLC is derived. As a result, one global stabilization on CVC is proposed by regulating the angle between the saturated current vector and d-axis. Finally, the maximum system boundary of the first swing can be obtained by placing stable equilibrium points (SEPs) under CLC on the right switching line.