

Stability Improvement and Control Optimization of Isolated Two-Stage AC-DC-DC Converter Systems

Abstract

As the renewable integration trend continues, more and more power electronic converters are required as the interfaces between different networks in the power systems. However, the direct interaction of the converters introduces uncertainties to the power systems, especially for the stability and reliability.

This thesis focuses on the instability issues of the dual active bridge (DAB) converter-based two-stage DC-DC-AC systems and addresses their concerns. Specifically, the full-order impedance model of the DAB converter is presented for the first time to facilitate the stability analysis. Based on the impedance model, the effects of different DAB modulation schemes on the stability have been analyzed and the optimal modulation method is investigated from the point of view of stability. The proposed feedback controller optimization method is effective to improve the stability of the two-stage system. Moreover, a family of impedance shaping regulators is proposed to suppress the dc-bus voltage ripples.