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Stability Issues of Cascaded DC-DC Converter Systems

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Abstract

In an electrical system, DC-DC converters are major constituents that control the power flow among various terminals including power sources, buses and loadings. Stability of these constituent converters under all operating conditions is vital to the operation of the electrical system. In this paper, a simple DC cascaded system consisting of two cascading averaged current-mode controlled DC-DC converters is considered. Application of the impedance criteria allows a fast and decoupled design of a stable cascaded system. However, the usual impedance criteria fail to correctly predict the stability of the system. Slow-scale instability has been observed from full circuit simulations, discrete-time analysis and experimental measurements. The complex behavior caused by the slow-scale instability such as border collision has been analyzed in depth based on the discrete-time model. Stability boundaries are derived in practical parameter space. Finally, effective methods for ensuring stable design of current-mode controlled cascaded DC converter systems are discussed.

About the Speaker

Li Ding received the B.E. degree and M.E. degree from Guangdong University of Technology and South China University of Technology in 2011 and 2014 respectively. He was a Research Assistant from 2015 to 2016 with the Department of Electronic and Information Engineering Electronics Engineering, Hong Kong Polytechnic University. He is now pursuing the PhD degree at the Department of Electronic and Information Engineering, Hong Kong Polytechnic University. His research interests include modeling and stability analysis of DC distributed system.