

ECE – 590 I

POWER & ENERGY SYSTEMS SEMINAR

Monday, November 14, 2016, 4:00 – 5:00 p.m., Room 3017, ECEB

A High Power Density Power Factor Correction Front End Based on a Flying Capacitor Multilevel Converter

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Abstract

Power factor correction (PFC) AC-DC converters find wide applications in grid-connected systems. This work presents a PFC front end based on a 7-level flying capacitor multilevel (FCML) boost converter. The operation of the FCML converter will be introduced to illustrate its benefits in terms of efficiency and power density. Compared to conventional 2-level boost converter design, the proposed 7-level FCML converter features the use of low-voltage-rating transistors and a high effective switching frequency. These characteristics of FCML converter lead to drastic reduction in the filter inductor size while maintaining high efficiency and small heat sink volume, and thus significantly improve the power density. On the other hand, the small inductance imposes unique challenges in the implementation of the PFC control. In this work, a digital control implementation is presented to overcome these challenges. A hardware prototype is designed for universal AC input (90~Vac to 265~Vac), 400~V DC output and 1.3~kW power rating, and its performance has been experimentally demonstrated.

Power Network Topology Control for Mitigating the Effects of Geomagnetically Induced Currents

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Abstract

Solar storms can induce quasi-dc geomagnetically induced current (GIC) flows in power grids, which could potentially lead to transformer damage and system stability and reliability issues. We consider the problem of designing operational GIC mitigation strategies by switching transmission lines. This topology control approach could relieve the power network from temporarily high level of GIC flows, without significantly affecting the security of grid operations. We will cast the problem as a mixed-integer linear program, and develop computationally tractable solutions using linear sensitivity analysis to select candidate lines to change status while maintaining system connectivity. The effectiveness of the proposed method has been demonstrated using a 20-bus GIC test case.