DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

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ECE TALK

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Optimization and Codesign of Power Electronics Converters

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Location: SEH B1220

Abstract

Optimization of individual components for power electronic converters relies heavily on model accuracy, component tolerances, and thermal constraints. While these constraints are well-known, medium frequency transformer optimization has been limited to nominal design optimization. This assumption results in a mismatch between the simulated and experimental results. Therefore, these potential sources of error have been reduced using robust optimization techniques in this work. A potential design region, capturing 97.7% of all potential transformer designs, is calculated due to statistical deviations in the design, and the experimental result is shown to be within this region.

Currently, power electronic converters are designed by limiting the degrees of freedom by selecting a switching frequency or available components. Based on the previous results, I propose a new method of power electronics converter design which integrates multidomain component design into the converter-level optimization. For example, the degradation of wide bandgap devices caused by switching frequency, short-circuit time, and temperature dependencies is affected by the cooling system and its limitations. This enables a codesign that integrates the mechanical and electrical structures of the converter and its individual components into a seamless process that will benefit the entire system. The potential impacts of this methodology include better packaging at the component- and converter-levels and unique converter designs that will increase the reliability and ruggedness of the converter.

Biography

Kristen Booth is a Postdoctoral Researcher at The Ohio State University in the Center for High Performance Power Electronics (CHPPE). As an NSF Graduate Research Fellow, Kristen completed her Ph.D. degree from North Carolina State University which will be conferred in December 2019. She graduated from NCSU with a M.S. in Electrical Engineering in 2017 and received the B.S.E. in Engineering Physics in 2015 from Murray State University. Kristen's research interests include resiliency and reliability of power electronics converters, optimization of medium frequency transformers, and power electronics for grid modernization.

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