UNIVERSITY AT BUFFALO
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THE SCHOOL OF ENGINEERING AND APPLIED SCIENCES

DEPARTMENT OF ELECTRICAL ENGINEERING

Graduate Seminar Guest Speaker

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Transformer Design Using Normalized Density Functions

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Knox 109

ABSTRACT

Size, performance, and cost of a power electronic system are closely linked to the like parameters of the inductive components. Since custom power transformers are widely used, transformer design is a frequent design process that has significant impact on system performance. Yet most high frequency transformers utilize less than 25% of the available core window for efficient current conduction. There are two factors which cause this relatively poor utilization; insulation requirements and eddy current losses. Insulation requirements generally limit total winding conductor cross sectional area to less than 35% of the available core window. Induced high frequency eddy currents often increase the apparent winding resistances by 50% or more. Therefore, less than 25% of the available core window is effectively utilized. Interleaved windings, multifilar conductors, Litz wire, and other approaches can decrease eddy current effects. However, these techniques add additional insulation penalties which further reduce the net cross sectional window area available for the winding conductors.

Despite much published literature concerning evaluation of transformer loss and energy at high frequencies, continued widespread interest in transformer design methods indicates that many designers seek more intuitive techniques to evaluate tradeoffs and assure an optimal configuration. This interest is understandable since many methods lead the designer to make repeated trial configurations until obtaining a satisfactory result. While FEA (Finite Element Analysis) and commercial software facilitate evaluation of many trial configurations, the designer's imagination of improved configurations is fueled by understanding and insight.

This seminar presents a transformer design approach using normalized loss and energy densities. This approach inspires concepts of equivalent winding thicknesses which intuitively display optimal conductor and interleaving configurations.

BIOGRAPHY

Victor W. Quinn received the Bachelor of Science degree in Physics from the University of Rochester and the Master of Science degree in Electrical Engineering from the Rochester Institute of Technology.

Mr. Quinn specializes in design and development of transformers and inductors, and has been designing magnetic components since 1980 for a wide variety of military, aerospace, and industrial applications. While focusing on improved performance and size reduction for demanding applications, Mr. Quinn developed effective design tools and test strategies to improve magnetic component development. Most recently as the Chief Technology Officer at Tabtronics, Inc., Mr. Quinn has developed novel technologies to achieve higher efficiency and size reduction for magnetic components used in power electronic applications.

Mr. Quinn's prior works have been published in the proceedings of the Applied Power Electronics Conference, Power Systems World, Principles and Applications of Magnetic Materials, Power Electronics for Distributed and Cogeneration and in the Journal of Micromechanics and Microengineering.

Mr. Quinn has conducted seminars at numerous Fortune 100 companies where there has been an avid interest in magnetic component improvements.