

IEEE DISTINGUISHED LECTURER PROGRAM PRESENTS:

RF ASPECTS OF MAGNETIC RESONANCE IMAGING

by Professor Robert H. Caverly (Villanova University)

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McMaster University

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McMaster University
1280 Main Street West, Hamilton, ON L8S 4K1**

ABSTRACT

Magnetic Resonance Imaging (MRI) scanners are an important diagnostic tool for the medical practitioner. They provide a non-invasive means of imaging soft tissues and allow for obtaining real-time images of the cardiovascular system and other dynamic changes in the human body. MRI scanners rely heavily on the expertise of electrical engineers: image processing, high speed computing and RF (radio frequency) systems and components. This presentation will focus on some of the RF aspects of the MR process and MR scanners. A primer on the physical phenomenon behind magnetic resonance will start the presentation and include a discussion of the origin of the MR signal. The need for the high static magnetic field (B_0), the use of gradient coils for MR signal location, simple RF pulse sequences and how they are used in image construction will be covered. This MR image construction process and the control of the various steps that manipulate the atomic nuclei to generate the final MR diagnostic image put demanding constraints on RF equipment capabilities and these will be discussed, along with a high-level overview of the various components making up conventional MRI systems. This overview will include various examples of transmit and receive RF systems, examples of transmit and receive coils for MR scanners, and system diagrams for both the RF transmit and receive paths. The talk will then narrow in scope to look at how these RF coils are modeled and controlled in both transmit and receive states, the components used for transmit/receive switching as well as patient and equipment protection.



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Dr. Robert H. Caverly has been a faculty member at Villanova University in the Department of Electrical and Computer Engineering since 1997 and is a Full Professor. Previously, he was a Professor for more than 14 years at the University of Massachusetts Dartmouth. Dr. Caverly's research interests are focused on the characterization of semiconductor devices such as PIN diodes and FETs in the microwave and RF control environment. He has published more than 100 journal and conference papers and is the author of the book *CMOS RFIC Design Principles*, Artech House. An IEEE Fellow (2013), Dr. Caverly is an Associate Editor of the *IEEE Microwave Magazine* and a member of the HF-VHF-UHF Technology (TC-17) and Biomedical Applications (TC-10) Technical Committees of the IEEE Microwave Theory and Techniques Society.