

# **ECE SEMINAR**

## **IEEE DISTINGUISHED LECTURE: ANISOTROPIC MEDIA AND METAMATERIALS WITH PRINTED CIRCUITS FOR NOVEL RADIO FREQUENCY DEVICES**

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**Wednesday, October 17, 4:10pm-5:10pm, Engineering B101**

### **ABSTRACT:**

It is well recognized that materials design holds a promise for developing novel and much smaller integrated Radio Frequency (RF) devices. Related research in this area is highly fueled by continuing growth in the commercial and defense industry for high bandwidth future communication systems. Not surprisingly, engineered materials, such as composites and periodic media have attracted considerable interest in recent years due to their remarkable and unique electromagnetic behavior. An extensive literature on the theory and application of artificially modified materials already exists, and applications to a variety of RF devices have been considered to harness their extraordinary propagation characteristics.

This presentation will discuss how modified materials, lumped loads and low loss magnetic materials/crystals (metamaterials) are impacting antenna design with a goal to overcome miniaturization challenges (viz. bandwidth and gain reduction, multi-functionality etc.). Material modification for impedance matching has, for example, led to significant size reduction and higher bandwidth low frequency antennas. Also, recent magnetic photonic crystals (MPCs) and non-magnetic versions of these crystals have demonstrated miniaturization and performance reaching the theoretical limits. A particular focus in this presentation will be the introduction of a new class of printed circuits that emulate anisotropic media and allow for control of the propagation properties by design. Such printed circuits can therefore lead to a variety of RF devices with novel functionalities, including small couplers and antenna elements.

Practical realization of new materials is poised to challenge fabrication, computational and design methods for a variety of RF applications. Some of these challenges, including current trends and capabilities will be also addressed.

### **BIOGRAPHY:**

John L. Volakis was born on May 13, 1956 in Chios, Greece and immigrated to the U.S.A. in 1973. He received his Ph.D. degree in 1982 from the Ohio State University where he spent his graduate student years (1978-82) at the ElectroScience Laboratory.

Prof. Volakis started his career at Rockwell International (1982-84), now Boeing Phantom Works. In 1984 he was appointed Assistant Professor at the University of Michigan, Ann Arbor, MI, becoming a full Professor in 1994. He also served as the Director of the Radiation Laboratory from 1998 to 2000. Since January 2003, he is the Roy and Lois Chope Chair Professor of Engineering at the Ohio State University, Columbus, Ohio and also serves as the Director of the ElectroScience Laboratory. His primary research deals with antennas,

computational methods, electromagnetic compatibility and interference, propagation, design optimization, new RF materials, multi-physics engineering and bioelectromagnetics. He has published over 250 articles in major refereed journals, nearly 380 conference papers and 20 book chapters. He is co-author to the following 4 books: *Approximate Boundary Conditions in Electromagnetics* (Institution of Electrical Engineers, London, 1995), *Finite Element Method for Electromagnetics* (IEEE Press, New York, 1998), *Frequency Domain Hybrid Finite Element Methods in Electromagnetics* (Morgan & Claypool, 2006), and edited the *Antenna Engineering Handbook* (McGraw-Hill, 2007). He has also delivered several short courses on numerical methods, antennas and frequency selective surfaces. In 1998 he received the University of Michigan (UM) College of Engineering Research Excellence award and in 2001 he received the UM, Dept. of Electrical Engineering and Computer Science Service Excellence Award. Dr. Volakis has graduated/mentored over 50 Ph.D. students/post-docs, and co-authored with them 8 best paper awards at conferences. He is listed by ISI as one among the top 250 most referenced authors.

Dr. Volakis was the 2004 President of the IEEE Antennas and Propagation Society, and currently serves as a Distinguished IEEE Lecturer. He was elected Fellow of the IEEE in 1996, and is a member of the URSI Commissions B and E. In 1993, he chaired the IEEE Antennas and Propagation Society Symposium and Radio Science Meeting in Ann Arbor, MI., and co-chaired the same Symposium in 2003 at Columbus, Ohio.

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