IEEE Miami Section Invited Webinar Announcement

“Conductive Textiles for Wearable Electronics”

**Speaker:** Dr. John L. Volakis  
**Date:** March 23, 2021 @ 1 pm  
**Zoom Link:** [https://fiu.zoom.us/j/93976220615?pwd=NkdlNjhiYS8rc3hDNldxZGRiS0RFZz09](https://fiu.zoom.us/j/93976220615?pwd=NkdlNjhiYS8rc3hDNldxZGRiS0RFZz09)

**Abstract:**
In recent years, a variety of flexible fabric-based electronics have been proposed. To this end, our team proposed a new class of conductive textiles that have demonstrated unique capabilities in terms of flexibility, durability and manufacturing-ease using standard automated embroidery machinery. These electronic threads (E-threads) have the capability to generate fully embroidered microwave circuitry that has the same electrical properties as traditional microwave circuits printed on PCBs. Concurrently, the developed embroidery process has been demonstrated to deliver the same accuracy as PCB technologies. Therefore, these new E-threads are providing for a path to realize full-scale wireless communication devices that are embroidered on wearable textile garments. They can therefore enable a new class of wearable devices that are not appendages, but rather fully intergraded and inconspicuousy placed within clothing.

A key manufacturing feature of the proposed E-textile is their bundling process. A single thread is comprised of several 15μm thick filaments. The inner core of the filament is comprised of a 10μm polymer (Zylon or Kevlar, among others), covered by a 5μm thick metallic coating. These filaments can be bundled into 6 or more to form a single thread for weaving into the garment. As such, a ‘printing’ resolution as good as 0.1 mm has been achieved. This resolution is nearly the same as that of standard Printed Circuit Boards (PCBs). Notably, by using the large surface of garments, a ten-fold increase in transmitted power of wireless signals can be achieved, enabling reliable communications at much longer distances.

Prototypes for sensors, RFID, antennas, WiFi boosters, and body imagers have been developed and tested for flexibility, mechanical robustness, and durability. These applications will be discussed at the meeting along with success stories for wearable wireless devices. However, several challenges remain in bringing reliable textile-based electronic devices, including wearable wideband transceivers, to the market. Among them, two challenges must be addressed: 1) reliable and repeatable interconnects, 2) chipsets that are less bulky and integrated with the textile circuitry in a reliable manner, 3) manufacturing costs. At the meeting, we will discuss these challenges and possible approaches to overcoming them.

**Speaker’s Bio**
John L. Volakis is the Dean of the College of Engineering and Computing at Florida International University (FIU), and a Professor in the Electrical and Computer Engineering Dept. He is an IEEE, AAAS, NAI, URSI and ACES Fellow. Prior to coming to FIU, he was the Roy and Lois Chope Chair in Engineering at Ohio State and a Professor in the Electrical and Computer Engineering Dept. (2003-2017). He also served as the Director of the Ohio State Univ. Electro Science Laboratory for 14 years. His career spans 2 years at Boeing, 19 years on the faculty at the University of Michigan-Ann Arbor, and 15 years at Ohio State. At Michigan he also served as the Director of the Radiation Laboratory (1998-2000).

Prof. Volakis has 38 years of engineering research experience, and has published over 435 journal papers, 900 conference papers, and over 30 chapters. In 2004, he was listed by ISI Web of Science as one of the top 250 most referenced authors, and his google h-index=71 with over 26000 citations (as of Jan 2021), among the largest in Engineering. He mentored nearly 100 PhDs/Post-Docs and has written with them 43 papers which received best paper awards. He is one of the most active researchers in electromagnetics, RF materials and metamaterials, antennas and phased array, RF transceivers, textile electronics, millimeter waves and terahertz, EMI/EMC as well as EM diffraction and computational methods. He is also the authors of 8 books, including the Antenna Handbook, referred to as the “antenna bible.” He is recognized worldwide for 1) introducing and establishing the finite method for microwave engineering, now the de facto method in commercial RF design packages, 2) novel composite materials for antenna & sensor miniaturization, 3) a new class of extremely thin and flexible wideband conformal antennas and arrays, and with over 30:1 of contiguous bandwidth, 4) textile surfaces for wearable electronics and sensors, and for 5) introducing battery-less and wireless medical implants for non-invasive brain signal collection.

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