



Arya Menon
Assistant Professor,
Texas A&M University

Multi-mode (Radar-Radiometer) Sensing for Security Applications: Improved Characterization of Hidden Dielectric Layers

Increasing threats of terrorism and contraband smuggling have led to a growing interest in high-frequency security sensors. Recently, systems combining active and passive microwave sensing into one unit have been proposed to improve reliability in the detection of contraband. However, the capability to measure material properties in real-time at stand-off distances of a few meters would greatly enhance the ability of security sensors to classify concealed items. This tutorial talk discusses a non-invasive approach to extract the complex permittivity and thickness of hidden or embedded dielectrics using multi-mode (active-passive) sensing. The design and operation of two types of microwave sensors are discussed – radar (active) and radiometer (passive) both operating in the K-band (18-26 GHz). Critical factors that degrade the performance of both systems often involve imperfections in the RF front-end as well as background clutter. To mitigate these issues, the following calibration techniques are presented to: (i) correct RF front-end distortion in frequency modulated continuous wave radars, (ii) correct mismatch and temperature dependent insertion loss contributions in the RF front-end of radiometers, and (iii) correct background noise for radiometers in indoor applications. The talk will conclude with a discussion on closed form models to predict the radar and radiometric responses of multi-layer dielectric targets. While presented from a security standpoint, the techniques presented in this talk may also be used in other applications like remote sensing, detection of buried fires, and food safety inspections.

Arya Menon is an Assistant Professor in the Department of Electrical and Computer Engineering at Texas A&M University (TAMU). Dr. Menon received the Bachelor of Engineering degree in electronics and communication from Manipal Institute of Technology, India in 2014, M.S. in electrical engineering from the University of South Florida in 2016, and Ph.D. in electrical and computer engineering from Oregon State University in 2021. She completed her postdoctoral fellowship at Texas A&M University in 2023. Her current research focuses on investigating bio-inspired intelligence in radar design. Her group focuses on three thrusts - hardware-software co-design for cognitive radars, creation of sharable wireless datasets, and sensor fusion with radar. Her other research interests include design of radiometers, sensor calibration techniques, and dielectric characterization methods. Her research has earned multiple awards and recognition including selection as a 2025 MTT-S Outstanding YP Lecturer, 2022 DARPA Riser for “*Bioinspired Hardware-Software Co-Design for Intelligent High-Frequency Active Sensors*,” the 2020 ARTFG Roger Pollard Student Fellowship (Silver), and the 2019 IEEE Microwave Theory and Techniques Society Graduate Fellowship, among others. Dr. Menon is also a passionate educator and was the recipient of the University of South Florida’s Provost’s Award for Outstanding Teaching in STEM by a Graduate Teaching Assistant in 2018 for her contributions towards developing laboratory experiments for a new undergraduate course in electromagnetics.



Shahid Ahmed
Principal Engineer,
TE Connectivity

Novel Features of Short-Pulse Ultrawideband Electromagnetics

Transient electromagnetic waves that exist for extremely short durations and rapidly decay are commonly classified as short-pulse electromagnetic phenomena. Owing to their inherent ultrawideband (UWB) nature, these pulses are capable of conveying exceptionally high information content. Because the area under the impulse waveform is very small, short-pulse signals contain minimal energy and therefore cause negligible interference with conventional radio-frequency communication systems. Their transient, burst-based transmission further enhances immunity to noise, enabling secure and reliable information transfer.

These distinctive features make short-pulse UWB technology attractive for a wide range of applications, including smart homes, advanced driver-assistance systems, keyless secure entry, healthcare, banking, security, peer-to-peer localization, and emerging social network platforms.

Beyond communications, recent investigations into the interaction of UWB pulses with biological systems have revealed another promising application domain. Experimental studies on human cells demonstrate that the biological response to UWB exposure depends strongly on pulse duration and field intensity. Notably, intense sub-microsecond pulses have been shown to induce programmed cell death, offering a potential non-invasive approach for reducing tumor growth.

Short-pulse electromagnetics can also be engineered to emulate extreme electromagnetic environments, such as nuclear electromagnetic pulses (NEMP) and lightning discharges. These capabilities are particularly valuable for aerospace and defense applications, including system hardening, survivability analysis, and electromagnetic compatibility testing.

This invited lecture will provide an overview of transient electromagnetics and its real-world applications across consumer electronics, medical technologies, aerospace, and defense. The presentation will also highlight recent advances in computational modeling, simulation, and visualization techniques used to address complex challenges in short-pulse electromagnetic analysis.

Shahid Ahmed is a Principal Engineer at TE Connectivity with extensive expertise in high-speed interface design, microwave engineering, and electromagnetics. His work spans both theoretical and experimental domains, including hardware development, measurements, and advanced computational modeling. Dr. Ahmed has played a key role in solving complex engineering and multiphysics problems, reflecting a broad and integrated understanding of electrical and electronics engineering.

As a leading author, Dr. Ahmed has published more than fifty papers in national and international journals and conference proceedings. He is also the author of the authoritative book *Electromagnetic Pulse Simulations Using Finite-Difference Time-Domain Method* (ISBN: 978-1-119-52617-9), which has become a significant reference in the field of short-pulse electromagnetics.

Dr. Ahmed is an active contributor to the engineering community through invited talks, workshops, and tutorials, underscoring his commitment to knowledge dissemination. He serves as a reviewer for leading journals, magazines, and U.S. Department of Energy SBIR/STTR proposals, and has chaired technical sessions and organized workshops at major international conferences.

A Senior Member of the IEEE with over a decade of membership, Dr. Ahmed is also affiliated with the IEEE Antennas and Propagation Society. In recognition of his professional achievements and technical leadership, he received the IEEE Hampton Roads Section Outstanding Engineer Award in 2013.