



# EMC Day

## September 10th, 2020

**Two Talks by IEEE Distinguished Lecturers  
Organized by Department of Electronics Engineering,  
Gebze Technical University At GTU Congress Center**

### PROGRAM

**Opening: 10:00 AM -10:10 AM**

**Talk 1: 10:10 AM -10:50 AM**

**Opportunities, Challenges, and Implementations of Silicon Integration and Packaging in mmWave Radar and Communication Applications by Dr. Xiaoxiong Gu**

**Tea/Coffee Break: 10:50 AM -11:00 AM**

**Talk 2: 11:00 AM -11:40 AM**

**From "Engineering ELECTROMAGNETICS" to "ELECTROMAGNETIC ENGINEERING": Teaching/Training Next Generations by Prof. Dr. Levent Sevgi**

### **Opportunities, Challenges and Implementations of Silicon Integration and Packaging in mmWave Radar and Communication Applications**

Co-design and integration of RFIC, package, and antennas are critical to enable multiple aspects of 5G communications (backhaul, last mile, mobile access) and are particularly challenging at mmWave frequencies. This talk will cover various important aspects of mmWave antenna module packaging and integration for base station, backhaul, and user equipment applications, respectively. We will first present a historical perspective on Si-based mmWave modules and approaches for antenna and IC integration including trade-offs. We will focus on the challenges, implementation, and characterization of a 28-GHz phased-array module with 64 dual polarized antennas for 5G base station applications. We will then introduce a software-defined phased array radio based on the 28-GHz hardware. The highly re-configurable phased array radio features beam shaping/steering control as well as data TX/RX function control from a single Python-based software interface. Second, we will present a W-band phased-array module with 64-element dual-polarization antennas for radar imaging and backhaul application. The module consists of a multilayer organic chip-carrier package and a 16-element phased-array TX IC or a 32-element RX IC chipset. Third, we will describe a compact, low-power, 60-GHz switched-beam transceiver module suitable for handset integration incorporating 4 antennas that supports both normal and end-fire directions for a wide link spatial coverage.



**Xiaoxiong Gu received the Ph.D.** in electrical engineering from the University of Washington, Seattle, USA, in 2006. He joined IBM Research as a Research Staff Member in January 2007. His research activities are focused on 5G radio access technologies, optoelectronic and mm-wave packaging, electrical designs, modeling and characterization of communication, imaging radar and computation systems. He has recently worked on antenna-in-package design and integration for mm-wave imaging and communication systems including Ka-band, V-band and W-band phased-array modules. He has also worked on 3D electrical packaging and signal/power integrity analysis for high-speed I/O subsystems including on-chip and off-chip interconnects. He has been involved in developing novel

TSV and interposer technologies for heterogeneous system integration.

Dr. Gu has authored over 90 peer-reviewed publications, 2 book chapters and holds 9 issued patents. He was a co-recipient of IEEE ISSCC 2017 Lewis Winner Award for Outstanding Paper and IEEE JSSC 2017 Best Paper Award (the world's first reported silicon-based 5G mmWave phased array antenna module operating at 28GHz). He was a co-recipient of the 2017 Pat Goldberg Memorial Award to the best paper in computer science, electrical engineering, and mathematics published by IBM Research. He received IBM Outstanding Research Accomplishment in 2019 and Outstanding Technical Achievement Award in 2016, four IBM Plateau Invention Awards in 2012 ~ 2016, the IEEE EMC Symposium Best Paper Award in 2013, two SRC Mahboob Khan Outstanding Industry Liaison Awards in 2012 and 2014, the Best Conference Paper Award at IEEE EPEPS in 2011, IEC DesignCon Paper Awards in 2008 and 2010, the Best Interactive Session Paper Award at IEEE DATE in 2008, and the Best Session Paper Award at IEEE ECTC in 2007. Dr. Gu is the co-chair of Professional Interest Community (PIC) on Computer System Designs at IBM. He is a Senior Member of IEEE and has been serving on different program committees for MTT-S, EPEPS, ECTC, EDAPS and DesignCon. Dr. Gu was the General Chair of IEEE EPEPS 2018 in San Jose, CA. He is also a Distinguished Lecturer for IEEE EMC Society in 2019-2020 and is currently an Associate Editor for IEEE Transactions on Component, Packaging and Manufacturing Technology.

**From ENGINEERING ELECTROMAGNETICS  
to ELECTROMAGNETIC ENGINEERING:  
Teaching/Training Next Generations**

**Abstract**

The role of Electromagnetic (EM) fields in our lives has been increasing. Communication, remote sensing, integrated command/ control/-surveillance systems, intelligent transportation systems, medicine, environment, education, marketing, defense are only a few areas where EM fields have critical importance. We have witnessed the transformation from Engineering Electromagnetics to Electromagnetic Engineering for the last few decades after being surrounded by EM waves everywhere. Among many others, EM engineering deals with broad range of problems from antenna design to EM scattering, indoor-outdoor radiowave propagation to wireless communication, radar systems to integrated surveillance, subsurface imaging to novel materials, EM compatibility to nano-systems, electroacoustic devices to electro-optical systems, etc. The range of the devices we use in our daily life has extended from DC up to Terahertz frequencies. We have had both large-scale (kilometers-wide) and small-scale (nanometers) EM systems. Large portion of these systems are broadband and digital, and have to operate in close proximity that results in severe EM interference problems. Engineers have to take EM issues into account from the earliest possible design stages. This necessitates establishing an intelligent balance between strong mathematical background (theory), engineering experience (practice), and modeling and numerical computations (simulation).

This keynote lecture aims at a broad-brush look at certain teaching / training challenges that confront wave-oriented EM engineering in the 21st century, in a complex computer and technology-driven world with rapidly shifting societal and technical priorities.

The lecture also discusses modeling and simulation strategies pertaining to complex EM problems and supplies several user-friendly virtual tools, most of which have been presented in the IEEE AP Magazine and which are very effective in teaching and training in lectures such as EM Wave Theory, Antennas and Radiowave Propagation, EM Scattering and Diffraction, Guided Wave Theory, Microstrip Circuit Design, Radar Cross Section Prediction, Transmission Lines, Metamaterials, etc.

**References**

- [1] L. Sevgi, *Electromagnetic Modeling and Simulation*, IEEE Press – John Wiley (EM Wave Series), NJ, Apr 2014.
- [2] L. Sevgi, *Complex Electromagnetic Problems and Numerical Simulation Approaches*, IEEE Press – John Wiley & Sons, May 2003.



**Prof. Dr. Levent Sevgi** is a Fellow of the IEEE. He received his B. Eng., M. Eng., and PhD degrees in Electronic Engineering from Istanbul Technical University (ITU) in 1982, 1984 and 1990, respectively. In 1987, while working on his PhD, he was awarded a fellowship that allowed him to work with Prof. L. B. Felsen at Weber Research Institute / New York Polytechnic University York for two years. His work at the Polytechnic concerned the propagation phenomena in non-homogeneous open and closed waveguides.

He was with Istanbul Technical University (1991–1998), TUBITAK-MRC, Information Technologies Research Institute (1999–2000), Weber Research Institute / NY Polytechnic University (1988–1990), Scientific Research Group of Raytheon Systems Canada (1998 – 1999), Center for Defense Studies, ITUV-SAM (1993 –1998 and 2000–2002) and with University of Massachusetts, Lowell (UML) MA/USA as a full-time faculty (2012 – 2013), with DOGUS University (2001-2014), and with Istanbul OKAN University (2014 - 2020).

He served one-term in the IEEE AP-S AdCom (2013-2015) and one-term and as a member of IEEE AP-S Field Award Committee (2018-2019). He has been an IEEE AP-S Distinguished Lecturer for the term 2020-2022. He has been the writer/editor of the “Testing ourselves” Column in the IEEE AP Magazine (since Feb 2007), a member of the IEEE AP-S Education Committee (since 2006), He has also served in several editorial boards (EB) of other prestigious journals / magazines, such as the IEEE AP Magazine (since 2007), Wiley’s International Journal of RFMiCAE (2002-2018), and the IEEE Access (2017-2019 and 2020 - 2022). He is the founding chair of the EMC TURKIYE International Conferences ([www.emcturkiye.org](http://www.emcturkiye.org)).

He has been involved with complex electromagnetic problems and complex communication and radar systems for nearly three decades. His research study has focused on propagation in complex environments; electromagnetic scattering and diffraction; RCS prediction and reduction; EMC/EMI modelling, simulation, tests and measurements; multi-sensor integrated wide area surveillance systems; surface wave HF radars; analytical and numerical methods in electromagnetics; FDTD, TLM, FEM, SSPE, and MoM techniques and their applications; bio-electromagnetics. He is also interested in novel approaches in engineering education, teaching electromagnetics via virtual tools. He also teaches popular science lectures such as Science, Technology and Society.

He has given dozens of seminars, invited/keynote talks, organized/presented several tutorials, training sessions and short courses from half-day to three-days in universities/institutes all around the World. He has published more than a dozen special issues / sections in many journals as a guest editor and/or a co-guest editor.

His recent keynote talks are: (i) From Engineering Electromagnetics towards Electromagnetic Engineering: Teaching, Training Next Generations in MMS’2018 Mediterranean Microwave Symposium, Istanbul / Turkey, and in EuCAP 2019 European Conference on Antennas and Propagation, Krakow / Poland, (ii) Radiowave Propagation Modeling and Simulation in APCAP 2019 Asia-Pacific Conference on Antennas and Propagation, Incheon / S. Korea, and (iii) From Design to Market: EMC Engineering in InCAP 2018 Indian Conference on Antennas and Propagation, Hyderabad / India.

He has published many books/book chapters in English and Turkish, over 180 journal/magazine papers/tutorials and attended nearly 100 international conferences/symposiums. His three books *Complex Electromagnetic Problems and Numerical Simulation Approaches*, *Electromagnetic Modeling and Simulation* and *Radiowave Propagation and Parabolic Equation Modeling* were published by the IEEE Press - WILEY in 2003, 2014, and 2017, respectively. His fourth book, *A Practical Guide to EMC Engineering* was published by ARTECH HOUSE in Sep 2017. His fifth book *Diffraction Modeling and Simulation with MATLAB* from ARTECH HOUSE will be published in Nov 2020.

His h-index is 32, with a record of nearly 3800 citations (source: Google Scholar, Aug 2020).