The Institute of Electrical and Electronics Engineers (IEEE)

Galveston Bay Section

EMC Chapter

EMC WEBINAR (not yet sponsored by GBS)

Join for a New Live Webinar with Antenna Experts!

THURSDAY, MAY 13

9:00 am – 11:00 am PDT

Sponsored by the IEEE EMC Society

THURSDAY, MAY 13, 2021 • 9:00 AM – 11:00 AM PDT

Antenna Fundamental Parameters and Figures-of-Merit

By Constantine A. Balanis

Regents Professor Emeritus, School of Electrical, Computer and Energy Engineering, Arizona State University, Tempe, AZ ***www.balanis.faculty.asu.edu***

Abstract: Antennas, single elements and arrays, are 'the electronic eyes and ears of the world.' They are the transitional devices and transducers that convert, in the transmitting mode, guided waves to free-space waves; similarly, in the receiving mode, they transform free-space waves to guided waves. In addition to transmitting and receiving EM energy, advanced breakthrough designs for system optimization accentuate the radiation energy in some directions and suppress it in others. Thus, antennas also serve as directional devices, in addition to radiating elements. They are used in a plethora of wireless applications ranging from personal, aerospace, and biomedical systems. In this presentation, some of the fundamental parameters and figures-of-merit of antennas, used to describe and judge their performance and radiation characteristics, will be reviewed. This includes amplitude patterns, beamwidths, directivity, gain, realized gain and bandwidths. When reciprocity is applicable, the parameters

Please check IEEE GBS website: https://site.ieee.org/gb/ for map and more.

are relevant in either the transmitting or receiving mode. They are based on the IEEE Standard Definitions of Terms for Antennas.

Basic Concepts of Antenna Characterization and Applications for EMC Measurements

By Zhong Chen, Director of RF Engineering, ETS-Lindgren, Cedar Park, TX

Abstract: There are some practical considerations for antennas used for EMC measurements; for example, EMC antennas are typically extremely broadband and low gain. At below 1 GHz, these antennas are used over a perfect electrical conductor (PEC) ground plane. This presentation provides an introduction and discussion of the antenna fundamental parameters from an application point of view, especially on how these antenna parameters are characterized and applied in EMC applications. We will review the definition of Antenna Factor (AF), its relationship to antenna gains, and mismatch losses. We will also look at other parameters often used in EMC applications, such as antenna balance, phase center, and site attenuation. A brief introduction to the EMC antenna calibration methods will be provided, including a reference to dipole-like antennas which are ubiquitous for EMC measurements below 1 GHz. Finally, we will discuss how these antenna parameters, such as the free-space antenna factors, are impacted by the presence of the conducting ground plane.

NOTE: Following the presentations, EMC Society President Alistair Duffy will moderate a LIVE Q&A session with the speakers. Bring your most pressing antenna questions!

MODERATOR BIOGRAPHY

Alistair Duffy is Professor of Electromagnetics and Director of the Institute of Engineering Sciences at De Montfort University (DMU), Leicester, UK. He received his BEng (Hons) and MEng degrees in 1988 and 1989, respectively, from University College, Cardiff, University of Wales. He read for his Ph.D. with Professors Christopoulos and Benson at Nottingham University, graduating in 1993. Dr. Duffy also holds an MBA from the Open University, UK, graduating in 2004. He was awarded his DSc from Cardiff University in 2019 for his body of research on the validation of computational electromagnetics. He is a Fellow of the IEEE and President of the IEEE EMC Society. He has published approximately 300 papers, mostly on his research interests of validation of computational electromagnetics; physical layer components, particularly communications

cabling; and electromagnetic compatibility testing.

SPEAKER BIOGRAPHIES

Zhong Chen is the Director of RF Engineering at ETS-Lindgren, located in Cedar Park, Texas. He has over 25 years of experience in RF testing, anechoic chamber design, as well as antenna and EMC field probe design and measurements. He is currently a member of the Antenna Measurement Techniques Association (AMTA) Board of Directors. Mr. Chen is the Chair of Subcommittee 1 of ANSI ASC C63 which is responsible for EMC antenna calibration and test site validation standards. He is also chair of the IEEE Standard 1309 committee responsible for developing calibration standards for field probes, and IEEE Standard 1128 for absorber measurements. He has served as a Distinguished Lecturer for the IEEE EMC Society. His research interests include measurement uncertainty, time domain measurements, and development of novel RF absorber materials. Mr. Chen received his M.S.E.E. degree in electromagnetics from the Ohio State University at Columbus.

Constantine A. Balanis (S'62 - M'68 - SM'74 - F'86 – LF'04) received the BSEE degree from Virginia Tech, Blacksburg, VA, in 1964, the MEE degree from the University of Virginia, Charlottesville, VA, in 1966, and the Ph.D. degree in Electrical Engineering from Ohio State University, Columbus, OH, in l969. From 1964-1970 he was with NASA Langley Research Center, Hampton VA, and from 1970-1983 he was with the Department of Electrical Engineering, West Virginia University, Morgantown, WV. Since 1983 he has been with the School of Electrical, Computer and Energy Engineering, Arizona State University, Tempe, AZ, where he is Regents Professor Emeritus. His research interests are in computational electromagnetics, and metasurfaces for low-profile, conformal and leaky-wave antennas, and RCS reduction using checkerboard metasurfaces. He received in 2004 an Honorary Doctorate from the Aristotle University of Thessaloniki (AUTH), the 2021 IEEE Electromagnetics Technical Field Award, the 2017 the IEEE Rudolph E. Henning Distinguished Mentoring Award, the 2014 James R. James, Lifetime Achievement Award, LAPC, Loughborough, UK, the 2012 Distinguished Achievement Award of the IEEE Antennas and Propagation Society, the 2012 Distinguished Achievement Alumnus Award (College of Engineering, The Ohio State University), the 2005 Chen-To Tai Distinguished Educator Award of the IEEE Antennas and Propagation Society, the 2000 IEEE Millennium Award, the 1996 Graduate Mentor Award of Arizona State University, the 1992 Special Professionalism Award of the IEEE Phoenix Section, the 1989 Individual Achievement Award of the IEEE Region 6, and the 1987-1988 Graduate Teaching Excellence Award, School of Engineering, Arizona State University.

Dr. Balanis is a Life Fellow of the IEEE. He has served as Associate Editor of the **IEEE Transactions on Antennas and Propagation** (1974-1977) and the **IEEE Transactions on Geoscience and Remote Sensing** (1981-1984); as Editor of the **Newsletter** for the IEEE Geoscience and Remote Sensing Society (1982-1983); as Second Vice-President (1984) and member of the Administrative Committee (1984-85) of the IEEE Geoscience and Remote Sensing Society; and Distinguished Lecturer (2003-2005), Chair of the Distinguished Lecturer Program (1988-1991), member of the AdCom (1992-95, 1997-1999) and Chair of the Awards and Fellows Committee (2009-2011) all of the IEEE Antennas and Propagation Society. He is the author of **Antenna Theory: Analysis and Design** (Wiley, 2016, 2005, 1997, 1982), **Advanced Engineering Electromagnetics** (Wiley, 2012,

1989) and **Introduction to Smart Antennas** (Morgan and Claypool, 2007), and editor of **Modern Antenna Handbook** (Wiley, 2008) and for the Morgan & Claypool Publishers, series on *Antennas and Propagation* series, and series on *Computational Electromagnetics*.