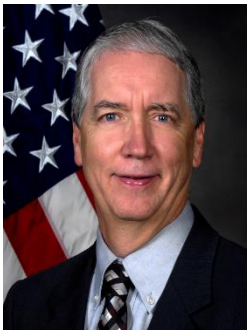
ROACH Technical Program
Presentation Abstracts and Speaker Bios
Version Date: October 3, 2018

KEYNOTE SPEAKER – OCTOBER 30

A Case Study of Engineers Responding to Unintended Public Policy Consequences – Assessing Electromagnetic Emissions from the L3-Comm Provision Airport Body Scanner System

Brian M. Kent, Ph.D., Chief Scientist, Applied Research Associates (BRD Division)

Abstract: During one's career, it is inevitable that an engineer may be exposed to an unexpected non-technical consequence having technical roots in a major public policy decision. This keynote outlines some high level case studies where engineering expertise is vital to resolve technical disputes. The chosen scenario is real – an unnamed passenger passes through an airport body scanner and is later diagnosed (within months) with stage 4 cancer. The passenger writes his congressman and claims the L3-Comm Provision body scanner "gave them cancer". The keynote describes what happened next and how such disputes are generally adjudicated. Next, I detail a specific and highly relevant topic to our EMC, Antenna and RF Microwave audience – how can one ***accurately predict, measure and quantify*** the calibrated emitted electromagnetic emissions of a TSA fielded production L3-Comm airport millimeter wave body scanner. In the end, the thorny safety issue is fully and publically addressed. My end goal is to inspire each of you to look for opportunities to apply your own specific scientific training to make at least one significant societal impact. The world beyond "work" needs your expertise, so given the opportunity, make a difference!



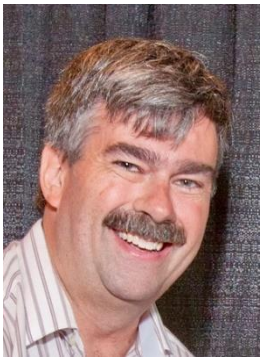
Speaker Biography: Dr. Brian M. Kent joined Applied Research Associates and currently serves as Chief Scientist and S&T Lead for Electromagnetics (EM), Radio Frequency (RF), and Sensing Systems. ARA is an employee-owned scientific research and engineering company founded in 1979 and dedicated to producing innovative solutions that tackle critical national problems in National Security, Infrastructure, Energy and Environment, and Health Solutions. (www.ARA.com) Dr. Kent will support corporate ARA technical efforts, and will work to expand S&T opportunities in his area of expertise. In addition, Dr. Kent continues to serve as Adjunct Professor of Electrical Engineering with Michigan State University's Department of Electrical Engineering. Dr Kent's technical work in ARA includes the design impacts of High Power Microwave Devices, instrumentation of static and dynamic radar measurement ranges, and the passive EMI emanations from commercial instrumentation.
Previously, Dr. Brian M. Kent was a member of the scientific and professional cadre of senior executives, and the Chief Technology Officer, Air Force Research Laboratory, Wright-Patterson Air Force Base, Ohio. He served as AFRL's principle scientific/technical advisor and primary authority for the technical content of the Science and Technology Portfolio. He evaluated the total Laboratory technical research program to determine its adequacy and efficiency in meeting national, DoD, USAF, AFMC, and AFRL objectives in core technical competency areas. He identified research gaps and analyzed advancements in a broad variety of scientific fields to advise on the their impact on Laboratory programs and objectives. He recommended new initiatives and adjustments to current programs required to meet current and future Air Force needs. As such, he is an internationally recognized scientific expert, and provides authoritarian counsel and advice to AFRL management and the professional staff as well as to other government organizations. He also collaborates on numerous interdisciplinary research problems that encompass multiple AFRL directorates, customers from other DOD components, as well as the manned space program managed by NASA. Dr. Kent is a Fellow of the Institute of Electrical and Electronics Engineering

and is a former IEEE Distinguished Lecturer for the Antenna and Propagation Society. He is also a Fellow of the Antenna Measurement Techniques Association and of the Air Force Research Laboratory. In 2009, he was a Meritorious Presidential Rank Awardee. His technical specialties include EM Scattering and material property measurements, Radar, Antenna, and Radar Cross Section Measurements, Radar Performance Evaluation, RF/EO Sensing Technologies, and Passive/Active Electronic Warfare.

KEYNOTE SPEAKER - OCTOBER 31

Stirring-Up Trouble: Hidden Challenges in Stirred Measurements Based on Simple DUT Failure Models
John Ladbury, RF Fields Group, National Institute of Standards and Technology (NIST), Boulder, Colorado

Abstract: The choice of whether to use stepping or stirring in a reverberation chamber measurement is often dealt with as if this is simply facilities decision…for stepping, use Procedure A, for stirring, use Procedure B. The characteristics of the DUT are simply ignored or addressed with a simple statement along the lines of "verify that the stirring speed insures that the field evolution is slow enough to detect susceptibilities." Such a statement does not adequately address the subtleties and complications that can be introduced by different possible DUT response types. In this presentation, we will discuss several different possible DUT response types, and open up the discussion to other types suggested by the audience. Then we will go through the effects of stirring (and stirring at different rates) and discuss how best to deal with these effects. This talk is meant to be interactive, and we hope that the audience can introduce new and even more complicated challenges into the discussion.



Speaker Biography: John M. Ladbury received the B.S.E.E. and M.S.E.E. degrees (specializing in signal processing) from the University of Colorado, Boulder, in 1987 and 1992, respectively. Since 1987 he has worked on EMC metrology and facilities with the Radio Frequency Technology Division of N.I.S.T. in Boulder, CO. His principal focus has been on reverberation chambers, with some investigations into other EMC-related topics such as time-domain measurements and probe calibrations. He was involved with the revision of RTCA DO160D and is a member of the IEC joint task force on reverberation chambers. He has been awarded four "Best Symposium Paper" awards at IEEE International EMC symposia, a Technical Achievement Award from the IEEE EMC Society for significant contributions in the development of reverberation chamber techniques for EMC applications, a US Department of Commerce Bronze Medal for his research in Reverberation Chambers, and a US Department of Commerce Gold Medal for his role in evaluating the impact of LTE wireless signals on the performance of GPS receivers.

FEATURED SPEAKERS

mmWave Communication Technology for Aviation
Anil Kumar & Aziz Yousif, The Boeing Company, Seattle, WA

Abstract: As a result of the ever-increasing data throughput demands inside modern aircrafts, more effective solutions to delivering prodigious amounts of data in a secure and reliable manner is becoming more challenging. As more passenger devices demand more data, frequency crowding exacerbates in the 2.4 and 5 GHz Wi-Fi frequency bands, underscoring the need for higher frequency bands in the mmWave region (30-300 GHz) for various applications. One possible solution capitalizes on shore-range, high throughput communication via 60 GHz - WiGiG, which uses the 57 – 64 GHz frequency band and

there may be other possibilities in 28 and 40 GHz bands to be decided at the WRC-19. However, unorthodox challenges in these frequency bands exist, such as high path loss, atmospheric absorption, and diffraction. In this work, different challenges specifically in an aircraft cabin environment are outlined, and achievements in the 60 GHz performance for some aircraft applications are discussed.

Speaker Biography: Anil Kumar is Boeing Technical Fellow in the BCA Airplane Systems organization as a Chief Architect of the Communication Systems and Network Management group, specializing in off-board and on-board connectivity. Anil led the effort as a spectrum management specialist in obtaining Ku-band spectrum for mobile satellite communications for the Connexion by Boeing business. He contributed towards standardization and certification of broadband satellite communications for commercial and military aircraft. This led to approvals for a world-wide operation of mobile SATCOM connectivity in Ku and Ka bands for both military and passenger In-Flight Entertainment (IFE) services on commercial aircraft. Anil contributed to the implementation of Radio Frequency Identification (RFID) and Wi-Fi systems on board aircraft to support airline operations and passenger connectivity. As a chairman of SAE G-18 committee he led a cross-aerospace industry effort in establishing the SAE AS 5678 for Passive and SAE AS 6023 for Active and Battery Assisted Passive (BAP) RFID standards for implementation on aircraft. He is on the board of advisors for the RFID Lab at Auburn University, AL. Anil is leading a cross-functional team across the industry to develop electronically steered broadband satellite antenna systems on aircraft to support Gate-to-Gate operation. He led the effort through FCC to lift the ban on 60 GHz band operation on board aircraft that is essential for high throughput applications on aircraft. Anil is a Member of IEEE Communications & Signal Processing group and has taught at UW, Tacoma and Embrey Riddle University, as well as the University of Technology, Sydney, Australia.

Advances in the Design of Anechoic Chambers for Today's Modern Vehicles
Zhong Chen, ETS-Lindgren, Cedar Park, Texas

Abstract: This presentation provides the latest information on chamber design for the EMC and antenna pattern measurements required of today's increasingly sophisticated military and commercial vehicles, such as electric and autonomous vehicles. It aims to provide information so a user can understand the limitations of absorbers, chamber design tradeoffs, and test methods to validate the performance goals. The presentation is divided into three parts. The first part addresses chamber designs for EMC applications typically specified in MIL-STD-461 for military applications as well as the automotive standards issued by CISPR, SAE and ISO for commercial applications. A brief introduction is provided on the requirements of the standard regarding chamber design. The second part concentrates on anechoic chamber designs for antenna or radar measurements. Basic design and performance guidelines are presented, and test requirements are discussed in terms of the Free Space VSWR method, which are typically used for these chambers. The third part of the presentation deals with absorber power handling for high power applications, which are often encountered in military vehicle measurements inside an anechoic chamber.

Speaker Biography: Zhong Chen is the Director of RF Engineering at ETS-Lindgren, located in Cedar Park, Texas. He has over 20 years of experience in RF testing, anechoic chamber design, as well as EMC antenna and field probe design and measurements. He is an active member of the ANSI ASC C63® committee and Chairman of Subcommittee 1 which is responsible for the antenna calibration and chamber/test site validation standards. He is chairman of the IEEE Standard 1309 committee responsible for developing calibration standards for field probes, and IEEE Standard 1128 for absorber measurements. His research interests include measurement uncertainty, time domain measurements

for site validation and antenna calibration, and development of novel RF absorber materials. Zhong Chen received his M.S.E.E. degree in electromagnetics from the Ohio State University at Columbus. He may be reached at zhong.chen@ets-lindgren.com.

Radar Cross Section Measurements and Associated Challenges
Sean Raffetto, The Boeing Company, Seattle, Washington

Abstract: Radar Cross Section (RCS) measurements are performed in multiple methodologies where each method has its positives and negatives associated with it. This presentation includes discussions on modern near-field and far-field measurements, compact and outdoor range measurements, calibration techniques, developments in post-processing, and the challenges associated with them.

Speaker Biography: Sean Raffetto is an Electrophysics Engineer for The Boeing Company. He has been in the Boeing Test & Evaluation organization specializing in the Radar Cross Section (RCS) measurements. Sean has a background in RCS and Antenna testing, Computational Electromagnetic Modeling (CEM), Inverse Synthetic Aperture Radar (ISAR), Image Editing and Reconstruction (IER) techniques, and other post-processing correction techniques. Sean received his Bachelor's degree in Applied Physics from the University of Washington in 2015 where he was also a four-year student-athlete on the Men's Rowing team.

Bench and Lab Testing 5G and IoT Enabled Devices: Where did all the Lab Space Go?
James Young, ETS-Lindgren, Cedar Park, Texas

Abstract: If you haven't been asked if adding some sort of wireless interface is possible for one of your company's products, just wait. Wireless enabled products are now so common that it is considered for even the most mundane items. The predictions are for wireless to reach literally any product as Internet of Things (IoT) and Gbps 5G mobile devices seek killer app status. So regardless of your area of engineering expertise, wireless is likely to become a topic of discussion, if not so currently. This session will cover why 5G and IoT devices will require significant changes to the lab, outline available solutions, and provide basic facts targeted toward software, hardware and EMC engineers. RF engineers are welcome to chime in as well.

Speaker Biography: James Young is the Director of Business Development for ETS-Lindgren. He is responsible for researching industry and customer requirements and then building solutions and relationships that serve our wireless, EMC and medical customers. James has spent nearly 20 years selling, designing and installing wireless and EMC test systems. Prior to joining ETS-Lindgren, he worked at AMETEK CTS and Rohde & Schwarz in various engineering, sales and marketing positions. James's engineering background includes system, ASIC and FPGA design for various communication, wireless and RF test products. He holds a BSEET from Weber State University and an MBA from the University of Phoenix.

STANDARDS PRESENTATIONS

Changes to ISO/IEC 17025:2017: A High Level Overview
By Chris Gunning, A2LA, Frederick, Maryland

Abstract: ISO/IEC 17025:2017 was released in November of 2017 with a 3 year implementation plan. This presentation is a high level overview of the changes made to ISO/IEC 17025 in this latest revision. In this presentation, we will review the significant and subtle changes to existing ISO/IEC 17025 laboratory systems, as well as the necessary steps to ensure conformity to the new Standard.

Speaker Biography: Christopher Gunning is currently the Life Sciences Accreditation Manager with the American Association for Laboratory Accreditation (A2LA) where he has been employed since 2009. He also has 10 years of laboratory experience in the biological field working in variety of regulatory environments from research through cGMP compliant vaccine production. This experience allows Mr. Gunning to appreciate the important role of a quality management system and technical competence both from a data defensibility standpoint and in generating customer confidence.

Addressing Errors Introduced with the Shift to Stirring in RTCA DO-160 G, Section 20
John Ladbury, National Institute of Standards and Technology (NIST), Boulder, Colorado

Abstract: When DO-160G, Environmental Conditions and Test Procedures for Airborne Equipment [1], Section 20.6, was modified in 2010 to simplify electromagnetic susceptibility measurements in a reverberation chamber and switch from a stepped paddle (mode-stepped or mode-tuned) to a continuously moving paddle (mode-stirred), an error was introduced which overestimates the test level by approximately 1.4 to 3 dB, and possibly more (the error should increase with exposure frequency). We offer a possible explanation for the cause of the error, and suggest several possible ways to give a more accurate estimate of the exposure field.

Speaker Biography: John M. Ladbury received the B.S.E.E. and M.S.E.E. degrees (specializing in signal processing) from the University of Colorado, Boulder, in 1987 and 1992, respectively. Since 1987 he has worked on EMC metrology and facilities with the Radio Frequency Technology Division of N.I.S.T. in Boulder, CO. His principal focus has been on reverberation chambers, with some investigations into other EMC-related topics such as time-domain measurements and probe calibrations. He was involved with the revision of RTCA DO160D and is a member of the IEC joint task force on reverberation chambers. He has been awarded four “Best Symposium Paper” awards at IEEE International EMC symposia, a Technical Achievement Award from the IEEE EMC Society for significant contributions in the development of reverberation chamber techniques for EMC applications, a US Department of Commerce Bronze Medal for his research in Reverberation Chambers, and a US Department of Commerce Gold Medal for his role in evaluating the impact of LTE wireless signals on the performance of GPS receivers.

Review of IEEE 1128 (RF Absorber Evaluation in the Range of 30 MHz to 5 GHz) PLUS
Update on Draft Standard ANSI C63.25 (Validation Methods for Radiated Emission Test Sites)

Zhong Chen, Chair of IEEE 1128 Working Group, Chair ANSI C63 Subcommittee 1, ETS-Lindgren

Abstract: A review will be provided of the current and proposed test methods for characterizing the absorption properties of typical anechoic chamber linings applied to a metallic surface as described in IEEE 1128. Many advances in RF absorber technology have taken place since IEEE 1128 was last published in 1998; attendees can learn about the state-of-the-art in current absorber technology that

will affect the current revision. Following this presentation, an update will be provided on ANSI C63.25, a new document on the application of Time Domain (TD) measurements for test site validation and antenna calibration. Attendees will quickly learn what is new in these standards, what to expect in the new revisions, and how this may influence their current EMC test and measurement activity. Attendees will also have a chance to contribute directly to the new standards revisions.

Speaker Biography: Zhong Chen is the Director of RF Engineering at ETS-Lindgren, located in Cedar Park, Texas. He has over 20 years of experience in RF testing, anechoic chamber design, as well as EMC antenna and field probe design and measurements. He is an active member of the ANSI ASC C63® committee and Chairman of Subcommittee 1 which is responsible for the antenna calibration and chamber/test site validation standards. He is chairman of the IEEE Standard 1309 committee responsible for developing calibration standards for field probes, and IEEE Standard 1128 for absorber measurements. His research interests include measurement uncertainty, time domain measurements for site validation and antenna calibration, and development of novel RF absorber materials. Zhong Chen received his M.S.E.E. degree in electromagnetics from the Ohio State University at Columbus. He may be reached at zhong.chen@ets-lindgren.com.

Military and Aerospace EMC Testing: Recent Advancements and Future Changes
Erik Borgstrom, Department Manager, EMI, Element Materials Technology, Minneapolis, Minnesota

Abstract: The primary test standard for Military EMC testing, MIL-STD-461, has recently been released at a new revision level -- 461G. This latest revision of MIL-STD-461 includes new (to the military) EMC tests that are a significant departure from previous versions of the standard. On the Aerospace side, the global standard for Aircraft EMC, RTCA/DO-160, is in the process of major revisions to some of the more difficult sections, which will also be a significant change from previous versions. This presentation will provide an overview of the EMC requirements in both of these standards, highlighting and delving deeper into:

- The similarities and differences between the two standards
- The significant changes in the recently published MIL-STD-461G
- The changes in progress for DO-160
- The lightning induced/indirect effects testing requirements in both standards

Speaker Biography: Erik Borgstrom has worked in the Electromagnetic Compatibility testing field for more than 30 years. As the EMI Department Manager at Element Materials Technology's Minneapolis Lab (formerly Environ Laboratories), he specializes in EMI testing for the Defense and Aerospace industries. Mr. Borgstrom is one of Element's representatives on RTCA Special Committee 135 (responsible for revising DO-160), where he has been active for over 20 years, serving as Change Coordinator for DO-160 Section 22 (Lightning Induced Transient Susceptibility) and Section 25 (Electrostatic Discharge). Mr. Borgstrom is also an active member of SAE, where he serves as the DO-160 Task Group Leader on the AE-2 Aircraft Lightning Committee, a contributing member of the AE-4 Aircraft HIRF Working Group, and as Secretary for the AE-4 Aircraft EMC Working Group. Mr. Borgstrom has written several articles and presented many papers at Symposia and Conferences hosted by IEEE, SAE, and other related organizations, all focused on EMC and/or Lightning for the Defense and Aerospace industries.

Update on the Telecom Certification Body (TCB) Council Activity and ANSI Standards: Testing Unlicensed Wireless Devices (ANSI C63.10) and Licensed Wireless Devices (ANSI C63.26)
Mark Briggs, Director of Verification Services Wireless Certification Body Program, UL, Beaverton, Oregon

Abstract: This presentation will provide a high level review of the latest lab accreditation, radio modular approval, as well as RF exposure requirements from the FCC and ISED Canada. Updates will be provided on proposed changes to the wireless test methods and procedures described in ANSI C63.10 and ANSI C63.26.

Speaker Biography: Mark Briggs is the Director of UL Verification Services Wireless Certification Body Program covering certification for US, Canada, Japan and Notified Body work for the EU's Radio Equipment and EMC Directives. Mark has been with UL since 2011, with a gap year at Intel where he worked on wireless charging. Between UL and Elliott Labs/NTS, Mark has more than 20 years of experience in EMC covering EMC and wireless testing, creating test software for EMC and DFS tests and performing Certification Body functions for the FCC, the Innovation, Science & Economic Development Canada (formerly Industry Canada) and the EU. He participates in several Working Groups for ANSI C63.10 and C63.26. Mark is also Secretary for the TCB Council. Mark holds an MS in EMC from the University of York in the U.K. and is a NARTE Certified EMC Engineer.

LIVE DEMONSTRATIONS

Title: Advanced Antenna Measurement Techniques Using Time Domain Transformation

Abstract: Time domain gating is an effective technique to remove reflections in antenna measurements. The vector frequency response is transformed to time domain via inverse Fourier transforms, and a time domain gate can be applied. This function is included in commercial vector network analyzers. Although its applications seem straightforward, the implementations and limitations can feel like a "black-box". There are quite a few nuances in the time domain gating applications which can affect the results. This demonstration provides an in-depth understanding of the time domain gating algorithm, especially gating band edge errors (or "edge effects"), mitigation techniques and the limitations of the post-gate renormalization method used in a VNA. We introduce an alternative edge mitigation method, which can improve the accuracy for many antenna measurement applications.

Presenter: Zhong Chen, ETS-Lindgren

Presenter Biography: Zhong Chen is the Director of RF Engineering at ETS-Lindgren, located in Cedar Park, Texas. He has over 20 years of experience in RF testing, anechoic chamber design, as well as EMC antenna and field probe design and measurements. He is an active member of the ANSI ASC C63® committee and Chairman of Subcommittee 1 which is responsible for the antenna calibration and chamber/test site validation standards. He is chairman of the IEEE Standard 1309 committee responsible for developing calibration standards for field probes, and IEEE Standard 1128 for absorber measurements. His research interests include measurement uncertainty, time domain measurements for site validation and antenna calibration, and development of novel RF absorber materials. Zhong Chen received his M.S.E.E. degree in electromagnetics from the Ohio State University at Columbus. He may be reached at zhong.chen@ets-lindgren.com.

Title: Reverberation Chamber Stirring Techniques and Antenna Effects

Abstract: Reverberation chambers have been used for many years in the Electromagnetic Compatibility Community (EMC) and more recently in the wireless industry. The statistical methods used to evaluate the fields inside these chamber require the collection of statistically independent samples. These samples can be generated by employing different stirring techniques such as mechanical mode stirring/tuning, spatial and frequency stirring. With the development of conductive fabric chambers and tents, another method of mechanical stirring is possible by movement of the fabric walls and is referred to in literature as a Vibrating Intrinsic Reverberation Chamber (VIRC). This demonstration will highlight the strengths and weaknesses of each of these techniques. Careful consideration must be given to the antenna placement inside the chamber. We will demonstrate the effects of direct and indirect antenna coupling as well as antenna gain on reverberation chamber measurements.

Presenters: Dennis Lewis, Boeing and Vignesh Rajamani, Exponent

Presenter Biography: Dennis Lewis received his BS EE degree with honors from Henry Cogswell College and his MS degree in Physics from the University of Washington. He has worked at Boeing for 29 years and is recognized as a Technical Fellow. He currently has leadership and technical responsibility for the primary RF, Microwave and Antenna Metrology labs. Dennis holds eight patents and is the recipient of the 2013 & 2015 Boeing Special Invention Award. He is a member of the IEEE and several of its technical societies including the Microwave Theory and Techniques Society (MTT-S), the Antennas and Propagation Society and the Electromagnetic Compatibility (EMC) Society. He serves as a Board Member and is a past Distinguished Lecturer for the EMC Society. He is a Senior Member, serves as Vice President on the Board of Directors for the Antenna Measurements Techniques Association (AMTA), and chaired its annual symposium in 2012. Dennis is a part time faculty member teaching a course on Measurement Science at North Seattle College and is chair of the Technical Advisory Committee. His current technical interests include aerospace applications of reverberation chamber test techniques as well as microwave measurement systems and uncertainties.

Presenter Biography: Dr. Vignesh Rajamani is an expert in the electromagnetic characterization and application of reverberation chambers and holds a position of Senior Associate at Exponent. A main thrust of his research and project experience in the area of reverberation chambers has been towards increasing test accuracy. His expertise includes statistical electromagnetics, validation and optimization techniques for computational electromagnetics, communication system test in complex multipath environments, EMI/C Issues with Unmanned Aerial Systems, antenna systems and radio frequency (RF) design, and estimation probability of failure of electronic systems due to electromagnetic interference and compatibility. He is the Vice President of Member Services for the IEEE Electromagnetic Compatibility (EMC) Society and involved with several technical committees and educational activities through the EMC Society. He is a Senior Member of IEEE and served as a distinguished lecturer for the IEEE EMC Society for term 2013-2014. He has lectured around the world on reverberation chamber test methodologies and has taught design engineering seminars for faculty and students at many universities focusing on challenges in engineering education and prepare the faculty to handle them by spreading a significant number of Project Based Learning (PBL) classes across the curriculum. Prior to joining Exponent, Dr. Rajamani was with Oklahoma State University (OSU) as a Visiting Assistant Professor where he taught courses in engineering design and performed research in probability of failure of electronic systems in harsh electromagnetic environments. He has also taught the reverberation chamber course at OSU for the past 10 years and served as subject matter expert for various standard bodies.