ADVANCE PROGRAM & REGISTRATION FORM

The IEEE Seattle Section

Electromagnetic Compatibility (EMC) Society Chapter

Antennas and Propagation (AP) Society, Microwave Theory and Techniques (MTT) Society, Electronic Devices (ED) Society Joint Chapter

Communications Society (ComSoc) and Vehicular Technology (VT) Society Joint Chapter

Proudly Present

Advances in Antenna/EMC/Wireless Test and Measurement:
A Colloquium and Exhibition

With Special Keynote Speaker
Professor Yahya Rahmat-Samii
University of California, Los Angeles (UCLA)

Wednesday, May 17, 2017

The Museum of Flight
9404 East Marginal Way
Seattle, WA 98108-4097

Program Outline

7:30 am	**REGISTRATION** **CONTINENTAL BREAKFAST**
8:00 am	**IEEE EMC Society Welcome** Dennis Lewis, The Boeing Company, Seattle EMC Chapter Chair
8:10 am	**EMC of Things: How the IoT Needs Electromagnetic Compatibility** **Update on the IEEE New Initiative on IoT** Mr. Mike Violette Founder and CEO, Washington Labs, Gaithersburg, Maryland
8:40 am	**KEYNOTE PRESENTATION** **Evolution of Reflector Antennas in Diverse Applications:** **From Archimedes' Burning Mirror to Innovative CubeSat Antennas** Yahya Rahmat-Samii Distinguished Professor, Member of the US National Academy of Engineering, Department of Electrical Engineering University of California, Los Angeles
10:00 am	**BREAK**
10:20 am	**An Overview of the 3GPP/LTE Narrowband Internet of Things (NB-IoT)** Dr. Hossam Fattah, Microsoft, Redmond, Washington
11:05 am	**Complex Challenges in Measuring 5G / Millimeter Wave Device Performance** By Mr. Jari Vikstedt, ETS-Lindgren, Cedar Park, Texas
11:50 am	**LUNCH**
12:50 pm	**Wireless Integration Interference Challenges (aka EMC for Highly Integrated Wireless Devices)** By Mr. Harry G. Skinner, Intel Labs, Hillsboro, Oregon
1:35 pm	**Over-the-Air Testing of Large Cellular Wireless Devices in Reverberation Chambers** Dr. Kate Remley, Distinguished Lecturer with the IEEE EMC Society NIST, Boulder, Colorado
2:20 pm	**BREAK**
2:40 pm	**Perpetual Computing: Technologies for Banishing Batteries** Dr. Joshua R. Smith, Associate Professor**,** Department of Computer Science and Engineering**,** Department of Electrical Engineering University of Washington
3:25 pm	**Optimizing the Radiated Performance of Wireless IoT Devices** Scott Prather, AT&T, Redmond, Washington
4:10 pm	**Closing Comments** Dennis Lewis, The Boeing Company, Seattle EMC Chapter Chair
4:15 pm - 6:00 pm	**SELF-GUIDED TOUR OF MUSEUM GALLERIES** Complimentary access to registered attendees only

NOTE: Tabletop displays (exhibits) will be open during registration, lunch, and all breaks. Access to the tabletop displays is available during the technical sessions, but the displays may not be manned during those times. The above program is subject to change without notice.

Presentation Abstracts

EMC of Things: How the IoT Needs Electromagnetic Compatibility
Update on IEEE New Initiative on IoT
By Mr. Mike Violette, Founder and CEO, Washington Labs, Gaithersburg, Maryland

Abstract: From standards to testing to spectrum to facilities to all things coexistence, the Internet of Things screams for EMC. The effort to connect to billions of devices to the Internet is well underway and, for many sectors, has already arrived. According to Cisco, globally-connected devices will increase from 16 billion to 26 billion between 2015 and 2020.* This represents an enormous opportunity for EMC engineers of every ilk: from antenna folks to box people to spectrum aficionados to have a spin at the game. The importance of the EMC Society, representing 12 difference Technical Committees—all with a stake in IoT—represents a diverse group of specialists that can play a positive role in the development of IoT. This presentation will cover some of the aspects of IoT, some of the jargon and scope of the global effort to connect everything to the Net.
*Cisco, VNI Complete Forecast Highlights Tool (2016), http://www.cisco.com/c/m/en_us/solutions/service-provider/vni-forecast-highlights.html ("Global" and "United States" selected).

KEYNOTE PRESENTATION
Evolution of Reflector Antennas in Diverse Applications: From Archimedes' Burning Mirror to Innovative CubeSat Antennas
By Yahya Rahmat-Samii, Distinguished Professor, Member of the US National Academy of Engineering, Department of Electrical Engineering, University of California, Los Angeles, USA

Abstract: Reflector antennas are perhaps the most recognized type of antennas with vast applications in satellite communications, radars, wireless communications, remote sensing, planetary missions, radio astronomy and others. This is an antenna topology that is never gets old with ample modern applications. Typical frequency ranges of operations have been as low as the P-band, microwave, millimeter wave, and as high as Terra Hertz and optical. Reflector antenna designs have evolved from simple single parabolic dish with a solid surface to sophisticated mesh and membrane reflector antennas with multiple surfaces. The basic role of a reflector antenna is to confine most of the electromagnetic energy captured over their apertures into a focal plane or redirect the radiated field of the feed into the far field. This invited keynote talk focuses on a concise history of reflector antenna evolution over an extended historical time span, dating back to Archimedes, and links it to the recent and challenging developments of innovative reflector antennas for CubeSats, etc. The author particularly confines his presentation material to the areas that have influenced his research activities including novel designs and optimizations, simulations and measurements of reflector antennas. The material presented in this overview talk is the summarized version of many journal and conference papers and book chapters co-authored by the author and his contributions to the original designs of many currently functioning communications, remote sensing, radio astronomy and radar antenna systems**.**

An Overview of the 3GPP/LTE Narrowband Internet of Things (NB-IoT)
By Dr. Hossam Fattah, Microsoft, Redmond, Washington

Abstract: 3GPP 5G technology has introduced a new radio interface, NB-IoT and massive IoT, aiming at connecting a large and dense number of devices in a wide range of application domains forming so-called Internet of Things (IoT). Connected devices are to communicate through cellular infrastructure, device-to-device communication, or over a relay network. With this new interface, a new UE category has also been introduced that is suitable for IoT; in the

range of 10s of kbps (LTE Cat-NB1). 5G NB-IoT is designed with target requirements and goals and different mode of operations to cover the wide and vast variations in applications, deployment scenarios, and smart connectivity. This technology promises to create a highly connected world with a projection of billions of connected devices over the coming decade. In this talk, we go over the new 3GPP 5G proposal for IoT, its architecture, design, and key features. We will explain the target performance goals, different modes of operations, and supported uses cases and scenarios.

Complex Challenges in Measuring 5G/Millimeter Wave Device Performance
By Mr. Jari Vikstedt, ETS-Lindgren, Cedar Park, Texas

Abstract: As new 5G/millimeter wave technologies become increasingly implemented into the modern wireless environment, we face new and unique challenges of verifying the product first and foremost meets the regulatory requirements for EMC. The SMART antenna systems used in today's products make the test methodologies that have been used for decades obsolete. New innovative test methods need to be developed. Secondly, 5G/millimeter wave products are primarily designed to be used for communication. Measuring the performance of the device with adaptive antenna systems (AAS) creates test challenges. In this presentation we will demonstrate these problems and outline possible solutions for how to effectively measure some of these parameters.

Wireless Integration Interference Challenges (aka EMC for Highly Integrated Wireless Devices)
By Mr. Harry G. Skinner, Intel Labs, Hillsboro, Oregon

Abstract: Wireless communication on everything is fast becoming the norm. Unfortunately adding wireless functionality to devices has its own challenges. One of those challenges is the close proximity of intentional wireless transceivers with high speed digital circuitry. This talk is intended to introduce broad concepts related to what is widely known as radio frequency interference. Subject matter will include both platform and RF communications based interference sources and victims. It will cover foundational aspects related to differences between unintentional and intentional radiators including coexistence challenges. As well as addressing current challenges and possible solution paths, the talk will also look ahead at potential challenges related to future communications standards and devices.

Over-the-Air Testing of Large Cellular Wireless Devices in Reverberation Chambers
By Dr. Kate Remley, IEEE EMC Society Distinguished Lecturer
National Institute of Science and Technology (NIST), Boulder, Colorado

While the smartphone comes to mind when cellular technology is mentioned, the number of machine-to-machine device applications is also on the rise. These devices may take on large form factors such as parking kiosks, vending machines, car dashboards and the fast growing area of wearable devices that must be tested on body phantoms. Reverberation chambers can provide a relatively low-cost, repeatable laboratory environment for testing these larger cellular wireless devices. However, for some key metrics, the chamber set-up must provide channel conditions similar to those in which the receiver was designed to operate. This may require additional loading of the chamber, complicating both test procedures and uncertainty analyses. We discuss methods for configuring reverberation chambers and assessing uncertainty in the measurement of large-form-factor cellular devices.

Perpetual Computing: Technologies for Banishing Batteries
By Dr. Joshua R. Smith, Associate Professor, Department of Computer Science and Engineering, Department of Electrical Engineering, University of Washington

Abstract:
The energy efficiency of computing has improved by a factor of about one trillion since the electronic computer was invented. This astounding energy efficiency scaling is creating the opportunity for battery-free sensing and computing systems that are powered by radio waves and other ambient energy sources. Such devices can be implanted inside the body, permanently built into structures, or deployed at scales where batteries and wires are infeasible. My group's work aims to enable battery-free, perpetual computing. I will describe our work on RF energy harvesting, wireless power transfer, and ambient backscatter communication, as well as sensor systems built using these building blocks. I will also describe research challenges in areas from solid-state devices to networking that could help make perpetual computing systems a reality.

Optimizing the Radiated Performance of Wireless IoT Devices
By Mr. Scott Prather, AT&T, Redmond, Washington

Abstract: With the rapid deployment of products intended to support the wireless "Internet of Things", it's very important to ensure that the radiated performance of these devices will meet customer expectations. However, the assessment of wireless IoT device radiated performance can be complicated due to restrictions associated with the device's form factor or its intended use. In addition, the device's radiated performance can often be significantly compromised by lack of attention to EMC. This presentation describes the concepts behind the measurement of radiated performance, as well as the specific challenges associated with ensuring that wireless IoT devices will meet customer expectations across a broad range of device types, form factors and use cases.

About the Speakers

Hossam Fattah, Ph.D., P.Eng., received his Masters and Ph.D., degrees both in Electrical & Computer engineering from the University of Victoria and University of British Columbia, British Columbia, Canada in 2000 and 2003, respectively. Since then, he has been with the industry working on many wireless standards and technologies including IEEE 802.15.4 (ZigBee), cdma2000, CDMA-1X-EV-DO, IEEE 802.16 (WiMax), IEEE 802.11 (WiFi), UMTS, Long-Term Evolution (LTE), and LTE-advanced. He is currently with Microsoft as a senior engineer working on different networking technology in Microsoft products and services. His industry and research interests are in the area of wireless communication systems, resource management and scheduling, cross-layer and PHY-layer optimization, and wireless protocols design and validation. He has many peer-reviewed conference, journal, and patent technical publications. He is also a registered Professional Engineer (P.Eng.) in the Province of British Columbia, Canada.

Scott Prather has worked in the wireless communications industry since 1979. His experience encompasses 14 years in the paging industry, three years in the fixed wireless industry, and the remainder in the mobile wireless industry. Since 1999, Scott has been with the Subscriber Product Engineering group of AT&T in Redmond, WA, where he holds the position of Lead Product Development Engineer.

Scott currently serves as co-chair of the CTIA OTA Working Group. He also serves as co-chair of the CTIA ICS Task Force and the PTCRB Notebook Workgroup. Scott is also a frequent contributor to the CTIA W-IoT Radiated Performance Sub Group. Through his participation in these industry groups, Scott is actively involved in the development of test specifications for current and future mobile communications devices. For example, as chair of the PTCRB Notebook Workgroup, he led the development of a streamlined certification process for notebook computers based on electromagnetic noise signature analysis. He has also authored numerous AT&T internal white papers addressing such topics as the use of reverberation chambers for radiated performance measurement, physical-layer design considerations for W-CDMA mobile devices, and the impact of disparate emission masks on new and existing spectrum allocations. Scott is a senior member of the IEEE, and holds the IEEE Wireless Communications Professional (WCP) certification. He currently holds 10 patents pertaining to electromagnetic compatibility or test methodologies unique to wireless communications devices.

Yahya Rahmat-Samii is a Distinguished Professor, holder of the Northrop-Grumman Chair in electromagnetics, member of the US National Academy of Engineering (NAE), winner of the 2011 IEEE Electromagnetics Field Award and the former chairman of the Electrical Engineering Department at the University of California, Los Angeles (UCLA). Before joining UCLA, he was a Senior Research Scientist at Caltech/NASA's Jet Propulsion Laboratory. Dr. Rahmat-Samii was the 1995 President of the IEEE Antennas and Propagation Society and 2009-2011 President of the United States National Committee (USNC) of the International Union of Radio Science (URSI). He has also served as an IEEE Distinguished Lecturer presenting lectures internationally.

Dr. Rahmat-Samii is a Fellow of IEEE, AMTA, ACES, EMS and URSI. Dr. Rahmat-Samii has authored or co-authored over 1000 technical journal articles and conference papers and has written over 35 book chapters and five books. He has over fifteen cover-page IEEE publication papers. In 1984, he received the Henry Booker Award from URSI, which is given triennially to the most outstanding young radio scientist in North America. In 1992 and 1995, he received the Best Application Paper Prize Award (Wheeler Award) of the IEEE Transactions on Antennas and Propagation. In 1999, he received the University of Illinois ECE Distinguished Alumni Award. In 2000, Prof. Rahmat-Samii received the IEEE Third Millennium Medal and the AMTA Distinguished Achievement Award. In 2001, Rahmat-Samii received an Honorary Doctorate Causa from the University of Santiago de Compostela, Spain. In 2001, he became a Foreign Member of the Royal Flemish Academy of Belgium for Science and the Arts. In 2002, he received the Technical Excellence Award from JPL. He received the 2005 URSI Booker Gold Medal presented at the URSI General Assembly. He is the recipient of the 2007 Chen-To Tai Distinguished Educator Award and the 2009 Distinguished Achievement Award of the IEEE Antennas and Propagation Society. He is the recipient of the 2010 UCLA School of Engineering Lockheed Martin Excellence in Teaching Award and the 2011 campus-wide UCLA Distinguished Teaching Award. In 2015, he received the Distinguished Engineering Educator Award from The Engineer’s Council. In 2016, he received the John Kraus Antenna Award of the IEEE Antennas and Propagation Society and the NASA Group Achievement Award.

Prof. Rahmat-Samii has had pioneering research contributions in diverse areas of electromagnetics, antennas, measurement and diagnostics techniques, numerical and asymptotic methods, satellite and personal communications, human/antenna interactions, RFID and implanted antennas in medical applications, frequency selective surfaces, electromagnetic band-gap structures, applications of the genetic algorithms and particle swarm optimizations, etc., His original antenna designs are on many NASA/JPL spacecrafts for planetary, remote sensing and Cubesat missions (visit http://www.antlab.ee.ucla.edu/). Prof. Rahmat-Samii is the designer of the IEEE AP-S logo which is displayed on all IEEE AP-S publications.

Kate A. Remley (S’92–M’99–SM’06–F’13) was born in Ann Arbor, MI, USA. She received the Ph.D. degree in electrical and computer engineering from Oregon State University, Corvallis, OR, USA, in 1999. From 1983 to 1992, she was a Broadcast Engineer in Eugene, OR, serving

as the Chief Engineer of an AM/FM broadcast station from 1989 to 1991. In 1999, she joined the Electromagnetics Division of the National Institute of Standards and Technology (NIST), Boulder, CO, USA, as an Electronics Engineer. She is currently the Leader of the Metrology for Wireless Systems Group at NIST, where her research activities include development of calibrated measurements for microwave and millimeter-wave wireless systems, characterizing the link between nonlinear circuits and system performance, and developing standardized test methods for RF equipment used by the public-safety community. Dr. Remley received the Department of Commerce Bronze and Silver Medals, an ARFTG Best Paper Award, and is a member of the Oregon State University Academy of Distinguished Engineers. She was the Chair of the MTT-11 Technical Committee on Microwave Measurements from 2008 to 2010 and the Editor-in-Chief of IEEE Microwave Magazine from 2009 to 2011.

Harry Skinner is a Director and Senior Principal Engineer in Intel Labs. Since joining Intel in 1996, Harry has held a variety of positions, all dealing with Electromagnetic Compatibility (EMC). For the vast majority of his tenure Harry has directed Intel's EMC/EMI Research and Development while driving industry EMC guideline development for initiatives such as PCI Express* and SATA. More recently Harry has been driving Intel's research for Radio Frequency Interference (RFI) and Antennas. Other noteworthy projects include dithered clocks for IA platforms (SSC), ATX SE EMI containment guidelines (u-seam and waveguide implementations), and EMI design of Intel's mobile modules. Before coming to Intel, Harry spent six years with IBM. He has been awarded more than twenty patents, has multiple patents pending, and has published numerous papers at IEEE symposiums and other technical forums. Harry received a first-class honors Bachelor of Engineering (B.Eng) degree in electronics and electrical engineering from the University of Glasgow, Scotland.

Joshua R. Smith is an Associate Professor in the departments of Computer Science and Engineering and Electrical Engineering at the University of Washington, Seattle, where he leads the Sensor Systems research group. He was named an Allen Distinguished Investigator by the Paul G. Allen Family Foundation and he is the thrust leader for Communications and Interface in the NSF Engineering Research Center (ERC) for Sensorimotor Neural Engineering. In recent years his research has focused on wirelessly powering and communicating with sensor systems in applications such implanted biomedical electronics, ubiquitous computing, and robotics. Previously, he co-invented an electric field sensing system for suppressing unsafe airbag firing that is included in every Honda car. He received B.A. degrees in computer science and philosophy from Williams College, the M.A. degree in physics from Cambridge University, and the Ph.D. and S.M. degrees from the MIT Media Lab's Physics and Media group.

Jari Vikstedt is the Manager, Wireless Solutions for ETS-Lindgren in Cedar Park, Texas. He has over 20 years of experience with ETS-Lindgren in developing and testing RF test solutions for both EMC and Wireless applications. Mr. Vikstedt and the other engineers at ETS-Lindgren are active technical contributors to the leading wireless industry organizations, including the CTIA, 3GPP, IEEE and the Wi-Fi Alliance®. Recently Mr. Vikstedt has devoted his expertise to the development of CTIA and 3GPP Over-The-Air (OTA) testing solutions as well as developing innovative 5G OTA test solutions. He holds a BSEE degree in RF Engineering from the Turku University of Technology, Finland.

Mike Violette is a Professional Engineer and is founder and CEO of Washington Laboratories and founder and Director of American Certification Body. He has worked in compliance since 600 MHz seemed like a high frequency and has authored numerous articles and publications for and about the industry.

Event Overview

The Program

This program was designed to bring the latest information related to RF, EMC, and Antenna measurement techniques and standards to the local community. Experts in the industry and academia will share practical information on various topics in an extended presentation format. This allows a thorough discussion of each topic and provides the opportunity for extended questions and answers. The "hands-on" quality of the presentation enables the registrant to learn useful information that can be used on the job – in the "real world."

The Exhibition & Museum Tour

There will be an exhibition by vendors of EMC, Wireless and Antenna test and measurement related products and services in the technical presentation area. These products and services address the needs of the commercial, military, and aerospace industries.

From 4:15 to 6:00 pm only, the Museum of Flight is open to everyone *registered* to attend this event. Those wearing IEEE event badges only may take a complimentary self-guided tour of the museum galleries.

Colloquium and Exhibition Location

The Museum of Flight
The Skyline Room, Second Floor
9404 East Marginal Way
Seattle, WA 98108-4097

Parking Information

There is no charge for parking in the Museum of Flight parking lot.

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Registration Information

NOTE – THERE IS NO CHARGE FOR IEEE MEMBERS AND GUESTS TO ATTEND THIS COLLOQUIUM AND EXHIBITION – HOWEVER: SPACE IS LIMITED!!!

REGISTRATION IS REQUIRED IN ADVANCE TO OBTAIN ENTRY TO THE SKYLINE MEETING ROOM ON THE SECOND FLOOR - NO EXCEPTIONS

Please print clearly and mail OR click here to register on line

Name:_____

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IEEE Member: Y___ **N**___

IEEE #: _____

Full-time Student: Y___ **N**___

School: _____

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NOTE: The registration fee includes one copy of the colloquium handout, continental breakfast, lunch, refreshment breaks, and the self-guided museum tour. The organizing committee reserves the right to substitute speakers, restrict size, or to cancel the colloquium and exhibition. Substitutions are allowed. Attendance is limited. ***Registration will be confirmed on a first come, first served basis as SPACE IS LIMITED.***