

# **ADVANCE PROGRAM**

# **REGISTRATION FORM**

**The Antenna Measurement Techniques Association  
(AMTA)**



*In Cooperation with the*

Rio de Janeiro Joint IEEE Chapter of the  
Antennas and Propagation Society  
Microwave Theory and Techniques Society  
Electron Devices Society



*Proudly Presents*

**Advances in Antenna Test and Measurement**

**Tuesday, 5 April 2011**

**AGÊNCIA NACIONAL DE TELECOMUNICAÇÕES (ANATEL)  
CAUS , Qd. 6, Bl. H  
Brasília, DF, Brasil**

# Program Agenda

9:30 am	<b>REGISTRATION</b> <b>COMPLIMENTARY REFRESHMENTS</b>
10:30 am	<b>Anatel Welcome</b> <i>Maximiliano Salvadori Martinhão</i>  <b>IEEE APS/AMTA Welcome</b> <i>Dr. Don Bodnar, MI Technologies</i>
10:45 am	<b>Aircraft Antenna Coupling Measurement Utilizing Statistical Discrete Frequency Stirring (DFS) Technique to Enable the Use of Intentionally Transmitting Portable Electronic Devices (T-PEDs) Onboard Aircraft</b> <i>Kenneth Kirchoff, The Boeing Company, Seattle, Washington</i>
11:30 am	<b>A Large Spherical Near-Field Arch Scanner for Characterizing Low Frequency Phased Arrays</b> <i>Dr. Donald Bodnar, MI Technologies, Suwanee, Georgia</i>
12:15 pm 1:15 pm	<b>LUNCH BREAK</b>  <b>Physically and Electrically Large Antennas for Antenna Pattern Measurements and Radar Cross Section Measurements in the Upper VHF and UHF Bands</b> <i>Dr. Vince Rodriguez, ETS-Lindgren, Cedar Park, Texas</i>
2:00 pm	<b>Design and Implementation of Large Planar Near-field Measurement Systems for Satellite Antenna Measurements</b> <i>Greg Hindman, Nearfield Systems Inc (NSI), Torrance, California</i>
2:45 pm 3:05 pm	<b>COMPLIMENTARY REFRESHMENTS</b>  <b>Thermal Imaging Techniques (Infrared Thermograms) for Measuring Microwave Fields</b> <i>Johannes Nordgaard, NASA/JSC, E3 Lab, Houston, Texas</i>
3:50 pm	<b>Current Antenna Metrology Research at the National Institute of Standards and Technology (NIST)</b> <i>Perry Wilson, NIST, Boulder, Colorado</i>
4:35 pm to 5:30 pm	<b>CONCLUDING REMARKS</b> <i>Maximiliano Salvadori Martinhão, Anatel</i> <b>RECEPTION</b>

# TECHNICAL PROGRAM

## *Presentation Abstracts*

**Presentation Title:** Aircraft Antenna Coupling Measurement Utilizing Statistical Discrete Frequency Stirring (DFS) Technique to Enable the Use of Intentionally Transmitting Portable Electronic Devices (T-PEDs) Onboard Aircraft  
*By Kenneth Kirchoff, The Boeing Company, Seattle, Washington*

**Abstract:** As more airlines around the world are installing passenger communication systems that enable the use of passenger-owned intentionally transmitting portable electronic devices (T-PEDs), there is a requirement from an airplane safety perspective to ensure electromagnetic compatibility between the T-PEDs and the airplane communication, navigation and surveillance (CNS) systems. An FAA advisory special committee, SC-202, was convened to produce an industry accepted method for measuring the interference path loss (IPL), which is the coupling between a transmitter onboard the airplane and the airplane CNS antennas. Full scale airplane testing was undertaken to compare traditional deterministic test methods to a new statistical test approach. This presentation outlines a new method for determining the IPL for each CNS system that utilizes a statistical approach to find the upper bound coupling with known confidence levels.

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**Presentation Title:** A Large Spherical Near-Field Arch Scanner for Characterizing Low Frequency Phased Arrays  
*By Dr. Donald Bodnar, MI Technologies, Suwanee, Georgia*

**Abstract:** A spherical near field arch based measurement system has been developed for testing large phased array radars at low frequencies of operation. The near field scanner system consists of a 10 meter radius arch with an active probe position error correction and a large azimuth axis capable of carrying large arrays. The shielded anechoic chamber designed to house the measurement system includes full treatment with curvilinear absorber to achieve low levels of stray signal at UHF band frequencies, fire protection and a glycol based system for removing heat loads generated by the radars. The overall measurement system details are presented along with mechanical accuracies achieved for the scanner system. Details of the chamber and host facility are described. Finally, the paper concludes with measurements of a UHF-band Standard Gain Horn measured using the system. The challenges and benefits of such a system will be highlighted.

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**Presentation Title:** Physically and Electrically Large Antennas for Antenna Pattern Measurements and Radar Cross Section Measurements in the Upper VHF and UHF Bands  
*By Dr. Vince Rodriguez, ETS-Lindgren, Cedar Park, Texas*

**Abstract:** In recent years there has been increasing interest within the defence and commercial industries in performing antenna measurements at very low frequencies. This presentation shows the concept of the open boundary quad-ridge horn (OBQH) antenna first introduced in 2005 now scaled to lower frequencies. The concept has been taken to extremes by also opening the feed cavity of the horn leaving a fully unbounded antenna. The resulting antenna, although large in size, offers excellent VSWR and gain. The antenna is designed to perform both as a standalone unit or mounted to the wall of a chamber nested in the absorber treatment. Computed data is shown to show the difference between these configurations. Additionally, measured results on a prototype are shown. The Extremely Open Boundary Quad-ridge Horn (XOBQRH) concept can be applied at other frequencies. A 400 MHz to 10 GHz design and its results are also shown.

**Presentation Title:** Design and Implementation of Large Planar Near-field Measurement Systems for Satellite Antenna Measurements

*By Greg Hindman, Nearfield Systems Inc (NSI), Torrance, CA USA*

**Abstract:** NSI has been the leading supplier of large planar near-field scanner systems for satellite antenna test applications in the world. Since NSI's first 6.7 m x 6.7 m horizontal planar scanner system implemented for Space Systems Loral, in Palo Alto, California in 1992, NSI has worked on more than a dozen similar and larger systems for customers such as Boeing, Northrop Grumman, Thales Alenia Space France (TASF), Thales Alenia Space Italy (TASI), Lockheed, Orbital Sciences, and others. These types of scanners require precise probe position accuracy, and often include optical measurement systems and active dynamic position correction techniques. The presentation will describe methods used by NSI to maintain position accuracy, using a patented XYZ optical tracking system, as well as the use of dynamic cross-axis position correction techniques. Large scanners also present unique challenges to the RF measurement system implementation. The use of distributed frequency conversion equipment and special calibration techniques will also be discussed.

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**Presentation Title:** Thermal Imaging Techniques (Infrared Thermograms) for Measuring Microwave Fields

*By Johannes Nordgaard, NASA/JSC, E3 Lab, Houston, Texas*

**Abstract:** An infrared (IR) thermal imaging technique has been developed to measure electromagnetic (EM) fields. Infrared (IR) Thermograms (measured 2D temperature distributions) can be used to visualize the relative magnitude of the measured fields when presented as 2D isothermal contour plots and/or 3D relief maps. IR/Microwave Holograms can be used to extract the phase of the measured fields. This thermal technique can also be used to independently validate and verify (V&V) numerical codes used for computational electromagnetic (CEM) field predictions. This thermal technique is applied in this paper to measure EM fields radiated from antennas, scattered by metallic and/or dielectric objects, and coupled through apertures. Using a color-temperature table calibrated at NIST/Boulder, the measured relative temperature distributions can be converted into equivalent absolute electric or magnetic field intensity distributions. Measured and predicted results are compared to provide confidence in the complementary measurement and modeling & simulation (M&S) methods. Examples of measured IR thermograms/holograms of EM fields are shown.

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**Presentation Title:** Current Antenna Metrology Research at the National Institute of Standards and Technology

*By Perry Wilson, NIST, Boulder, Colorado*

**Abstract:** The National Institute of Standards and Technology (NIST) has a long standing research program in the Electromagnetics Division on metrology related to antenna parameters. This talk will briefly describe some past highlights and then overview current research efforts. NIST helped pioneer the use of near-field measurements to determine antenna gain, polarization, and pattern. NIST currently has planar, cylindrical, and spherical near-field ranges, complemented by two extrapolation ranges. NIST research on antenna measurements above 110 GHz, on probe position error correction, on antenna range quiet zone quantification, and on range intercomparison will be highlighted.

## **SPEAKER BIOGRAPHIES**

**Dr. Donald G. Bodnar** is the Vice President of MI Technologies and is responsible for development of new business areas and products. Prior to joining MI Technologies, he was with the United States Air Force as Chief Scientist, Sensors Directorate of the Air Force Research Laboratory and prior to that as Chief Scientist, Rome Laboratory. Before joining the Air Force, Dr. Bodnar was a member of the research faculty at the Georgia Institute of Technology (GTRI) where he was a Division Chief and later a Laboratory Director. He specialized in antenna design and analysis, especially scanning reflector antennas and in the polarization characterization of antennas using both theoretical and experimental methods. He has performed antenna and RCS measurements using compact range, near-field and far-field measurement techniques. He is the past president of the Antenna Measurements and Techniques Association (AMTA), a Life Fellow of the IEEE, a past President and a past Vice President of the IEEE Antennas and Propagation Society, past Chairman of the IEEE Antenna Standards Committee, and is the author or co-author of over 100 publications.

**Greg Hindman** is the President and co-founder of Nearfield Systems Inc. (NSI). He began his career in antenna measurements in 1977 when he graduated from the University of Colorado with his BSEE and started working for TRW in Redondo Beach, California. At TRW, his first assignment was as a design and test engineer for antennas on the Tracking and Data Relay Satellite System (TDRSS). This project involved the commissioning of a number of new automated far-field antenna test ranges. Mr. Hindman managed the implementation of one of these far-field ranges and presented a paper on it at the first annual AMTA meeting in Atlanta in 1979. He has now authored more than 30 technical papers presented to AMTA and other symposia, and has received several best paper awards. He was also elected to a three year term on the board of directors of AMTA and served as Vice President. Mr. Hindman is currently a Fellow of AMTA. Mr. Hindman's involvement with near-field antenna measurements began in 1985 when he was responsible for commissioning TRW's first (6.7 m x 6.7 m) vertical planar near-field scanner for large satellite reflector antenna testing, and he became heavily involved in near-field facility design and testing. In 1988, Mr. Hindman co-founded Nearfield Systems, Inc. (NSI) where he serves as its President. At NSI, he has led the effort to make near-field antenna measurement systems more popular and affordable to industry. His technical focus in recent years has been in the area of measurement accuracy improvements in planar and spherical near-field measurement systems.

**Kenneth Kirchoff** received his BS EE (Cum Laude) from Seattle University and has completed MS EE courses at Columbia University in New York and the University of Washington in Seattle. Kenneth has served on FAA advisory committees as a chairman of technical working groups, advised foreign regulatory bodies such as the MIC in Japan on safety aspects of wireless devices onboard airplanes and currently serves as a co-chair of the ARINC AEEC Cabin Systems Subcommittee technical working group for wireless systems onboard airplanes. Kenneth has worked at the Boeing Company for 20 years, spending time as an electromagnetic effects engineer on programs such as the 767 Tanker and Connexion by Boeing® and as a systems engineer in cabin systems working on onboard mobile telephony systems. Kenneth currently serves as the principle investigator in 787 Cabin Systems research and development working on such technologies as software defined radio, aircraft wireless infrastructure and synthetic aperture scanning.

**Johannes Nordgaard (John Norgard)** (Georgia Tech-B.S.E.E./1966/Co-Op; Caltech-MS/1967/Applied Physics; Caltech-PhD/1969/Applied Physics) of NASA/JSC is the Chief Engineer for Electromagnetic Environmental Effects (E3). Prior to joining NASA, Dr. Norgard was a Professor at the University of Colorado at Colorado Springs, the President and CEO of ElectroMagnetic Techniques (EMT), Inc., the Chief Scientist of ZeeWaves, Inc., and the Senior Research Scientist for the Radar Techniques Branch of the Sensors Directorate at the Rome Research Site of the Air Force Research Lab [AFRL/RRS (SNRT)]. He has also been a Distinguished Visiting Professor (DVP) at the US Air Force Academy in the Electrical & Computer Engineering Department. He has taught graduate and undergraduate courses in Electromagnetic Field Theory for over 30 years and was the Director of the Electromagnetics Laboratory

at the University of Colorado. Before coming to the University of Colorado, he was a Professor in the Electrical Engineering Department at Georgia Tech and was a Post-Doctoral Fellow at the Norwegian Defense Research Establishment (NDRE) in Kjeller, Norway. He worked at the Jet Propulsion Laboratory (JPL) while studying at Caltech and was a Co-Op student at Georgia Tech while working at the Charleston Naval Shipyard (CNS). He has worked on numerous computational electromagnetic problems, including conformal antennas/apertures, strip lines/microstrips, waveguides/cavities and transmission lines, propagation of waves through various plasma media (polar ionosphere, rocket soundings), interaction and coupling of waves to wires (cross-talk, NEMP, and lightning), EMI, EMC, EMS/V, backscatter from clutter targets, ESD, HPM radiation, GPR, RF Tomography, and IR Metrology. He has developed a 2D thermal mapping technique using infrared thermography and microwave holography to measure electromagnetic fields and to verify and validate numerical CEM codes. He has been a Visiting Professor at the Tel-Aviv University and was a member of the technical staff of the Bell Telephone Laboratories. He is an Adjunct Professor at Syracuse University and at the University of Houston. He is a Fellow of IEEE for IR measurements of EM fields, a past member of the Board of Directors for the IEEE/EMC Society serving as the Vice President for Standards, on the Board of Physics and Astronomy for the National Academy of Sciences, Past Chairman for Commission A/Metrology of URSI, and an Associate Editor for the IEEE/EMC Transactions in the area of antenna metrology. He has authored several hundred technical papers, reports, and journal articles and has contributed chapters to four EM books.

**Vicente Rodríguez** attended The University of Mississippi (Ole Miss), in Oxford, MS, where he obtained his B.S.E.E. in 1994. During the fall of 1994, he joined the Department of Electrical Engineering at the University of Mississippi as a research assistant. During his tenure at the department, he completed his Master of Science and Doctorate degrees in the area of Engineering Science with an emphasis on Electromagnetic Theory in 1996 and 1999, respectively. In August 1999, Dr. Rodríguez joined the department of Electrical Engineering and Computer Science at Texas A&M University-Kingsville (formerly Texas A&I University) as a Visiting Assistant Professor. In June 2000, Dr. Rodríguez left the academic world when he joined EMC Test Systems (now ETS-Lindgren) as an RF and Electromagnetics engineer. During this time he was involved in the RF anechoic design of several chambers, including rectangular and taper antenna pattern measurement chambers, some of which operate from 100 MHz to 40 GHz. He was the principal RF engineer in the design and fabrication of the large Automotive/EMC/Satellite anechoic test chamber at INPE LIT in Brazil. In September 2004, Dr. Rodríguez assumed the position of Senior Principal Antenna Design Engineer, placing him in charge of the development of new antennas for different applications. Among the antennas developed by Dr. Rodríguez are new broadband double- and quad-ridged guide horns with a single lobe pattern and high field generator horns for the automotive industry. Dr. Rodríguez's interests include numerical methods in electromagnetics, especially when applied to antenna, EMC and RF/MW absorber design and analysis. Dr. Rodríguez is the author of more than twenty publications and holds patents for hybrid absorber and for a new double-ridged horn antenna. Dr. Rodríguez is a senior member of the IEEE and several of its technical societies including the AP, MTT and the EMC Societies. He is also a senior member of the Antenna Measurements Techniques Association (AMTA) and currently serves on its Board of Directors.

**Perry F. Wilson** (S'78-M'82-SM'93-F'05) received his Ph.D. in Electrical Engineering from the University of Colorado in 1983. He joined the Electromagnetics Division at the National Bureau of Standards (NBS) in 1983 as a National Research Council Postdoctoral Fellow. In 1987 he joined the Electromagnetics (EM) Group at the Asea Brown Boveri Corporate Research Center (then Brown Boveri). In 1998 he accepted a position with the Telecommunications Theory Division at the Institute for Telecommunication Sciences. In 1999 he re-joined the Electromagnetics Division at the National Institute of Standards and Technology (formerly NBS) in Boulder, Colorado where he is currently Acting Division Chief for the Electromagnetics Division. Dr. Wilson's research interests have focused on the application of electromagnetic theory to problems in electromagnetic compatibility and metrology. Dr. Wilson is a Fellow of the IEEE, past Editor-in-Chief of the IEEE Transactions on EMC, the current VP for Communications for the IEEE EMC Society, a member of URSI Commission B, and a member of the US IEC TC77B TAG. He received the IEEE EMC Transactions Best Paper Award in 2002 and an IEEE EMC Society Technical Achievement Award in 2010.

**Seminar Location**

AGÊNCIA NACIONAL DE TELECOMUNICAÇÕES (ANATEL)  
CAUS , Qd. 6, Bl. H - Brasília, DF, Brasil

**Seminar Organizing Committee**

***Arrangements***

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***Host***

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***Registration***

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**REGISTRATION FEES**

<b>Deadlines</b>	<b>IEEE/AMTA Members</b>	<b>Non Members*</b>
Received by March 20	<b>BR\$ 30</b>	<b>BR\$ 40</b>
Received from March 21 to on site (if space is available)	<b>BR\$ 45</b>	<b>BR\$ 55</b>
<p><i>*MEMBERSHIP: A credit of BR \$10 may be applied on site to a one year e-membership in IEEE.</i></p> <p><i>STUDENT DISCOUNT: Full time students are eligible for a 50% discount off the registration fees. A valid student identification card must be presented on site to gain access to the program.</i></p>		

**Registration Information**

*Please print clearly*

<b>Name:</b>	_____
<b>Title:</b>	_____
<b>Company:</b>	_____
<b>Street Address:</b>	_____
<b>City:</b>	_____ <b>State:</b> _____ <b>Zip:</b> _____
<b>Daytime Phone:</b>	_____
<b>IEEE Member:</b>	Y <input type="checkbox"/> N <input type="checkbox"/> <b>Member Number:</b> _____
<b>Full Time Student:</b>	Y <input type="checkbox"/> N <input type="checkbox"/> <b>Student ID Number:</b> _____
<b>Name of University or College:</b>	_____

# Registration by Fax/E-mail

Registration Total Per Fees Above \$ \_\_\_\_\_

Check Enclosed in Amount of: \$ \_\_\_\_\_

NOTE: Cash and check payments may be processed during the REGISTRATION from 9:30 to 10:30 on April 5. This registration form MUST BE ON FILE WITH THE REGISTRARS (André Kavaliéris) by March 20 or the higher registration fee effective March 21 will be applied on site.

## Return to:

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**NOTE:** The registration fee includes refreshment breaks and lunch. The organizing committee reserves the right to substitute speakers, restrict size, or to cancel the seminar. In the event the organizing committee cancels this event, registration fees only will be fully refunded. Individuals canceling their registration prior to March 20 will receive a full refund. No refunds will be made to individuals who cancel their registration after March 20. Substitutions are allowed.

**Attendance is limited. Registration will be confirmed on a first come, first served basis.**



**Announcement!** The IEEE Electromagnetic Compatibility (EMC) Society will hold a one day event at Anatel on **Monday, 4 April 2011**. For more information on the technical program and to register, please contact André Kavaliéris, AK Telemedia  
Phone: 55 11 74077473, Email: aktelemedia@gmail.com

*For more information on the EMC Society, visit [www.emcs.org](http://www.emcs.org).*