

2018 AMTA/IEEE REGIONAL SYMPOSIUM EVENT

Advance Program & Registration Form



in cooperation with the



IEEE Dayton Section

Joint Antennas & Propagation/Microwave
Theory & Techniques/Geoscience & Remote
Sensing Societies Chapter

IEEE Columbus Section

Joint Antennas & Propagation/Microwave
Theory & Techniques Societies Chapter

METAMATERIAL INSPIRED ANTENNAS AND DESIGNS

WEDNESDAY, APRIL 4, 2018

Hope Hotel & Richard C. Holbrooke Conference Center
Building #823, Area A, Gate 12A
Wright-Patterson Air Force Base, Ohio 45433

IMPORTANT NOTE: The Hope Hotel is outside the Wright Patterson Air Force Entry Gate; therefore no special paperwork or vehicle pass is required. **EVERYONE** is welcome!

PROGRAM AGENDA

7:30 am	REGISTRATION & CONTINENTAL BREAKFAST
8:30 am	AMT/IEEE WELCOME
8:45 am	Overview of Metamaterial-Inspired Research in the Tri-State Region <i>By Professor Prem Chahal</i> <i>Michigan State University</i>
9:30 am	Influence of Symmetry on Metamaterials-by-Design <i>By Professor Michael Havrilla</i> <i>Air Force Institute of Technology</i>
10:15 am	BREAK
10:45 am	Novel Materials and Fabrication Techniques for Millimeter-wave Metamaterials and Antennas <i>By Professor Nima Ghalichenian</i> <i>The Ohio State University</i>
11:30 am	LUNCH
12:30 pm	Does a Large Relative Permittivity Imply a Large Index of Refraction for Artificial Dielectric Materials? <i>By Dr. Keith Whites</i> <i>Applied Research Associates</i>
1:45 pm	Metamaterial Inspired High Impedance Ground Plane for Low-Profile Antenna Designs <i>By Dr. CJ Reddy</i> <i>Altair</i>
2:30 pm	BREAK
3:00 pm	Metasurface Engineering <i>By Dr. Richard Todd Lee</i> <i>Georgia Tech Research Institute</i>
3:45 pm	CLOSING REMARKS
4:00 pm to 6:00 pm	RECEPTION WITH SPEAKERS AND EXHIBITORS Raffle Prize Drawings

TECHNICAL PROGRAM

PRESENTATION ABSTRACTS

Overview of Metamaterial-Inspired Research in the Tri-State Region

By Professor Prem Chahal, Michigan State University

Abstract: Metamaterials as a construct have had a significant impact on research in “engineering materials” over the past 20 years. Engineered materials use more than one material to achieve some tailored electromagnetic property often described via the concept of permittivity and/or permeability. Metamaterials seek to achieve atypical properties such as “double negative (DNG)” where both the relative permittivity and permeability, at the same operating frequency, appear to be negative (for the real part of the complex constitutive properties). So-called classic metamaterials have had limited impact due to a number of inherent challenges. However, the concept of designing a structure to achieve atypical electromagnetic properties can be achieved for a variety of applications at least over a narrow bandwidth. A number of these are not classically metamaterials; rather, they are inspired by metamaterials. A number of the innovations in this area have come from the universities, Government laboratories and companies of the Midwest – a region that is a powerhouse in RF, microwave and millimeter-wave technology innovation. This presentation will provide an overview of many of these innovations. In particular, focus will be geared towards innovations in the area of design and fabrication.

Influence of Symmetry on Metamaterials-by-Design

By Professor Michael Havrilla, AFIT

Abstract: Recent advances in material fabrication capability (e.g., 3D printing) have made the rapid prototyping of engineered materials possible. In the field of electromagnetics, this capability has prompted substantial interest in evermore exotic media, such as hyperbolic and non-reciprocal metamaterials, due to the enhanced control one gains in manipulating the electromagnetic field for desired applications. The goal of this talk is to first provide a brief review of the fundamental aspects of symmetry. It will be explained how symmetry has a profound influence on material tensor properties and how symmetry can be exploited in designing metamaterials for various applications in electromagnetics and optics. A discussion of symmetry groups that may be utilized for non-reciprocal material design is also provided as an example due to the recent interest in this active research area. The next part of the talk discusses how the material tensor form influences the choice of analysis. The last part of the talk provides a simple example of a 3D printed reciprocal biaxial material which helps bring all the above concepts together.

Novel Materials and Fabrication Techniques for Millimeter-wave Metamaterials and Antennas

By Professor Nima Ghalichenian, The Ohio State University

Abstract: This talk will cover research activities in our group at The Ohio State University and the ElectroScience Laboratory in the areas of novel materials and fabrication processes for antennas, arrays, and frequency selective surfaces. Examples include millimeter wave reconfigurable antennas using mechanical phase change materials such as paraffin and electrically-tuned frequency selective surfaces using thin film of vanadium dioxide. Hybrid integration of 3D-printed metamaterials and lenses with microfabrication techniques provides further opportunities. A few examples will be reviewed. Measurement and electrical characterization results (complex permittivity) for the employed materials at the millimeter wave band will be presented.

Does a Large Relative Permittivity Imply a Large Index of Refraction for Artificial Dielectric Materials?

By Dr. Keith Whites, Applied Research Associates

Abstract: This talk will cover research activities in our group at The Ohio State University and the ElectroScience Laboratory in the areas of novel materials and fabrication processes for antennas, arrays, and frequency selective surfaces. Examples include millimeter wave reconfigurable antennas using mechanical phase change materials such as paraffin and electrically-tuned frequency selective surfaces using thin film of vanadium dioxide. Hybrid integration of 3D-printed metamaterials and lenses with microfabrication techniques provides further opportunities. A few examples will be reviewed. Measurement and electrical characterization results (complex permittivity) for the employed materials at the millimeter wave band will be presented.

Metamaterial Inspired High Impedance Ground Plane for Low-Profile Antenna Designs

By Dr. CJ Reddy, Altair

Abstract: Electromagnetic metamaterials have gained attraction in the past decade with research to employ them in electrically small and efficient antennas. In theory these materials are artificial structures that exhibit characteristics not found in nature. In practice, they can be realized by utilizing periodic structures. Metamaterial inspired high impedance surfaces (HIS), also known as artificial magnetic conductors have shown promise in miniaturization of antennas. These surfaces exhibit unique properties such as in-phase reflection of incident waves and the suppression of the surface waves. By utilizing these properties, antenna performance can be enhanced. In this talk, we will discuss design methodologies for various HIS structures. Application of HIS for efficient antenna designs and co-site coupling reduction will be presented.

Metasurface Engineering

By Dr. Richard Todd Lee, Georgia Tech Research Institute

Abstract: Metasurfaces enable a new avenue to engineered responses of the electromagnetic scattering characteristics through the control and manipulation of the wavefronts. The wavefronts are tuned by altering deeply sub-wavelength structural features on the metasurface. In this work, a heuristic technique is used where the conductive topology of the metasurfaces for a fixed form factor is optimized by a multi-objective genetic algorithm mimicking evolutionary processes. Analysis is performed for the engineered metasurface responses for frequency-selectivity, absorption, absorber characteristics, and photonic nanojet generation. Computational electromagnetic simulations for these engineered metasurfaces are presented and discussed. The concepts presented in this work can be applied to design metasurfaces and metamaterials from the microwave to the optical regimes.

SPEAKER BIOGRAPHIES

Professor Prem Chahal: Prem Chahal is currently an Associate Professor in the Department of Electrical and Computer Engineering at Michigan State University. He received the Ph.D. degree from Georgia Institute of Technology in 1999. He received his B.S. and M.S. degrees from Iowa State University both in Electrical and Computer Engineering. From 2006 – 2009 he held senior research position at Abbott Laboratories leading research in the area of BioMEMS. From 1999 – 2006 he was a principal engineer at Raytheon, Dallas leading research in the areas of THz technologies, MMIC design, RFMEMS, and nanoelectronics. Chahal is a recipient of the 2012 DARPA Young Faculty Award and 2016 Withrow Teaching Excellence Award.

His current research interests are in the area of THz technology, RF based Sensors, electronic systems packaging, and flex electronics.

Professor Michael Havrilla: Michael J. Havrilla received B.S. degrees in Physics and Mathematics in 1987, the M.S.E.E degree in 1989 and the Ph.D. degree in electrical engineering in 2001 from Michigan State University, East Lansing, MI. From 1990-1995, he was with General Electric Aircraft Engines, Evendale, OH and Lockheed Skunk Works, Palmdale, CA, where he worked as an electrical engineer. He is currently a Professor in the Department of Electrical and Computer Engineering at the Air Force Institute of Technology, Wright-Patterson AFB, OH. He is a member of URSI Commission B, a senior member of the IEEE and AMTA, and a member of the Eta Kappa Nu and Sigma Xi honor societies.

His current research interests include electromagnetic and guided-wave theory, electromagnetic propagation and radiation in complex media and structures, electromagnetic characterization of complex media and quantum field theory.

Professor Nima Ghalichehian: Dr. Nima Ghalichehian is an Assistant Professor at the Department of Electrical and Computer Engineering and the ElectroScience Laboratory at the Ohio State University (OSU). His research interests are in the area of RF microsystems. He is currently principal investigator of the RF Microsystems Laboratory located at room 210 of the ElectroScience Lab. He received his Ph.D. in Electrical Engineering in 2007 from University of Maryland, College Park where he developed electrostatic micromotors supported on microball bearings. From 2007 to 2012 he was with the Research Department of FormFactor Inc., Livermore, California as a Senior Principal Engineer. Dr. Ghalichehian joined OSU as a Research Scientist in 2012. From 2016 to 2017, he held a Research Assistant Professor position. As a principal investigator, he established new programs at OSU sponsored by NSF, DARPA, and industry partners.

Dr. Keith Whites: Dr. Keith W. Whites is Principal Scientist Manager and Advanced Electromagnetics and Materials Group Leader with the BerrieHill Research Division of Applied Research Associates, Dayton, OH. His research interests include most things electromagnetic, but focus primarily on electromagnetic materials. These interests include the analysis, design, and measurement of artificial electromagnetic materials; electromagnetic materials characterization; antenna miniaturization; high-impedance and textured surfaces; and direct-write fabrication of antennas and microwave frequency devices; among others. Dr. Whites received the B.S.E.E. degree from the South Dakota School of Mines and Technology, Rapid City, in 1986 and the M.S. and Ph.D. degrees from the University of Illinois at Urbana-Champaign, Urbana, IL, in 1988 and 1991, respectively. From 1991 to 2001, he was an Assistant and later an Associate Professor (with tenure) at the University of Kentucky in the Department of Electrical and Computer Engineering. From 2001 to 2018 he was a Professor in the Electrical and Computer Engineering Department at the South Dakota School of Mines and Technology, during which from 2001 to 2016 he was also the founding Steven P. Miller Endowed Chair. He has coauthored an electromagnetics textbook and is the author of more than 120 refereed journal and conference papers on various aspects of electromagnetics. Dr. Whites is the 1999 recipient of the R.W.P. King Prize Paper Award from the IEEE Antennas and Propagation Society and recipient of NSF Faculty Early Career Development (CAREER) and Research Initiation Awards.

CJ Reddy, PhD, Altair: Dr. C.J. Reddy is the Vice President, Business Development-Electromagnetics for Americas at Altair Engineering, Inc.(www.altair.com). At Altair, he is leading the marketing and support of commercial 3D electromagnetic software, FEKO (<http://www.altairhyperworks.com/product/FEKO>) in Americas. Dr. Reddy is also the President of Applied EM Inc (www.appliedem.com), a small company specializing in innovative antenna design and development. At Applied EM, Dr. Reddy successfully led many Small Business Innovative Research (SBIR) projects from the US Department of Defense (DoD). Dr. Reddy is a Senior Member of Institute of Electrical and Electronics Engineers (IEEE) and also a Senior Member of Antenna Measurement Techniques Association (AMTA). He has been elected Fellow of the Applied Computational Electromagnetic Society (ACES) in 2012. Dr. Reddy served on ACES Board of Directors from 2006 to 2012 and is currently serving as the Secretary of ACES. He published 37 journal papers, 77 conference papers and 18 NASA Technical Reports to date. Dr. Reddy is a co-author of the book, "Antenna Analysis and Design Using FEKO Electromagnetic Simulation Software," published in June 2014 by SciTech Publishing (now part of IET). Dr. Reddy was the General Chair of ACES 2011 Conference held in Williamsburg, VA during March 27-31, 2011. And also ACES 2013 conference, Monterey CA (March 24-28, 2013) as well as the General Chair of ACES 2015 conference held in Williamsburg, Virginia during March 22-26, 2015. He was the Co-General Chair of 2014 IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting held during July 6-11, 2014 in Memphis, TN. Dr. Reddy is the General Chair for AMTA 2018 conference to be held in Williamsburg, Virginia during November 3-8, 2018.

Dr. Richard Todd Lee: Dr. Richard Todd Lee earned his Ph.D. in 2009 in electrical engineering from Georgia Tech. He has been the Electromagnetics Division Chief since December 2016, following two years as the Antenna Theory and Design Branch Head. He has written key software packages that are used daily by ACL researchers, including KMAX, a full-wave phased-array simulation tool, and the optimization suite used for many of the pixelated antenna programs. He has designed numerous antennas for customers, including the UHF/VHF Band Array Antenna for the Cobra Ball platform. He has been the PI or co-PI on numerous programs, including a \$5.5M DARPA effort and a \$12M multi-year IDIQ with the US Government. Dr. Lee applies fundamental principles to solve problems that have spanned six orders of magnitude across the electromagnetic spectrum, resulting in HF, VHF, UHF, L, S, C, X, Ku, and Ka antenna designs, as well as diffractive structure designs in the infrared and optical bands. Many of these projects have resulted in recognition both inside GTRI and in the larger technical community. He has been a key member of teams that won the 2011 GTRI Innovative Research Award and 2012 One GTRI Collaboration Award, as well as a finalist for similar awards on multiple occasions. He is a member of the Institute of Electrical and Electronics Engineers, Applied Computational Engineering Society, and Eta Kappa Nu, as well as a reviewer for the IEEE, Royal Society of London, Optical Society of America, and the European Association for Computer Graphics. He has been invited to speak at several IEEE and government events, including the 2014 Tri-Service Radar Symposium, in which he was asked to present in a special session, and then participated (at DARPA's request) in an hour-long panel discussion on reconfigurable apertures. Similarly, he was invited by the AFOSR to participate in the 2016 Reconfigurable Electronics Working Group, which is helping the government to formulate a strategy for reconfigurable electronics over the coming decades.

2018 AMTA/IEEE REGIONAL SYMPOSIUM EVENT OVERVIEW

The Program

This program was designed to bring the latest metamaterial inspired technology related to antenna design, antenna measurement, radar, material design, and EMC to the local community. Experts in industry, academia and government organizations 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 demonstrations provide a unique educational opportunity to see selected presentation material “live”.

The Exhibition & Reception

There will be an exhibition by vendors of test and measurement related products and services for antenna, wireless, and metamaterial applications in the technical presentation area. These products and services address the needs of the commercial, military, and aerospace industries.

During the reception from 4:00 to 6:00 pm, heavy appetizers and a hosted bar will be available. AMTA and IEEE members are welcome to attend the reception only at NO CHARGE, provided a registration form is completed and sent in advance. A badge will be available for the reception-only attendees upon arrival at 4:00 pm. *Thus, if you can't join us for the entire day, drop by for the reception and exhibition to network with AMTA and IEEE. You can see demonstrations, meet the speakers, and you might even win a raffle prize!*

Event Location

HOPE HOTEL & RICHARD C. HOLBROOKE CONFERENCE CENTER

Building #823, Area A, Gate 12A
Wright-Patterson Air Force Base, Ohio 45433

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Local Hotels

Many options exist for lodging, including Hope Hotel, in the Dayton area.

ORGANIZING COMMITTEE

Dr. Michael Havrilla – AMTA BoD Vice President
Dr. Jeffrey Bean – AMTA BoD Technical Coordinator
Ed Urbanik, AMTA BoD Secretary
Donnie Gray – AMTA BoD Meeting Coordinator
Michelle Taylor – AMTA BoD Meeting Coordinator Advisor
Dr. Chi-Chih Chen – AMTA BoD Past President (2015)

Sponsorships and Exhibits

For Questions, contact Michelle Taylor, AMTA BoD Meeting Coordinator Advisor
Office: 678-475-8345, Email: meeting-advisor@amta.org

Registration

Please register through the AMTA Website at: www.AMTA.org or use the form on the following page.

For Questions, contact Michelle Taylor, AMTA BoD Meeting Coordinator Advisor
Office: 678-475-8345, Email: meeting-advisor@amta.org

REGISTRATION FEES	
AMTA/IEEE Members, if received by March 16, 2018	\$155
AMTA/IEEE Members, after March 16 and On-Site	\$275
Non-Member Additional Charge*:	\$ 50
Full-time Students with copy of valid Student I.D.	\$ 20
NOTE: Unemployed/retired attendees will receive a 50% discount off the AMTA/IEEE Member fees above.	
*Includes one-year membership in AMTA.	

NOTE: The registration fee includes a flash drive of the colloquium record, continental breakfast, lunch, refreshment breaks, and the reception. The organizing committee reserves the right to substitute speakers, restrict size, or to cancel the colloquium and exhibition. In the event the organizing committee cancels this event, registration fees only will be fully refunded. Individuals canceling their registration prior to March 16, 2018 will receive a full refund, less 10% credit card fee. No refunds will be made to individuals who cancel their registration after March 16, 2018. Substitutions are allowed. Attendance is limited; registration will be confirmed on a first come, first served basis.

Registration Information

Please print clearly

Name: _____

Title: _____

Company: _____

Street Address: _____

City: _____ State: _____ Zip: _____

Daytime Phone: _____

E-mail Address: _____

AMTA or IEEE Member: Y___ N___

IEEE #: _____

Full-time Student: Y___ N___

School: _____

(Please attach copy of Student ID to obtain Student rate.)

Do you plan to attend a Self-Guided Tour of the AF Museum on Thursday? Y___ N___

Registration Total per Fees Above

Check Enclosed in Amount of: \$ _____

(Checks payable to: AMTA)

Or

Credit Card Payment – Please Provide:

Name on Card: _____

Credit Card No: _____

Expiration Date: _____

Amount Charged: \$ _____

Signature: _____

Mail to:

AMTA/IEEE Regional Symposium Event Registration

c/o Michelle Taylor

NSI-MI Technologies

1125 Satellite Blvd., #100

Suwanee, GA 30024

E-mail to: meeting-advisor@amta.org