INTERNATIONAL SYMPOSIUM ON ELECTROMAGNETIC THEORY (EMTS 2019)

May 27-31, 2019, San Diego, CA, USA

Final Call for Papers

The International Symposium on Electromagnetic Theory (EMTS 2019) will be held May 27-31, 2019, in San Diego, CA, USA. It is organized by Commission B (Fields and Waves) of the International Union of Radio Science (URSI), and is financially cosponsored by the United States National Committee for URSI (USNC-URSI) and the IEEE Antennas and Propagation Society (IEEE AP-S). EMTS 2019 is the 23rd event in the triennial series of international EMT symposia, which has a long history since 1953. Its scope covers all areas of electromagnetic theory and its applications. It is the major scientific event of Commission B, along with the URSI General Assembly and Scientific Symposium, Atlantic Radio Science Conference (AT-RASC), and Asia Pacific Radio Science Conference (AP-RASC). The venue is the hotel Westin San Diego, which is minutes from downtown activities including the San Diego Zoo, Balboa Park and its numerous museums, and the Gaslamp district for dining and nightlife. San Diego is the eighth largest city in USA, and is often referred to as "America's Finest City." Known for its great hotels, beautiful weather, pristine beaches, friendly people, and a plethora of entertainment, San Diego is a favorite destination for visitors across the globe. The San Diego airport is conveniently close to our symposium venue, so transportation to the conference will be quick and easy.

Welcome to San Diego in May 2019! The conference will offer plenary talks by distinguished speakers, regular oral and poster sessions, and a one-day school for young scientists (May 27), focusing on a topic in electromagnetics. A number of Young Scientist Awards will be offered, covering the registration fee and accommodation during the conference. In addition, business meetings, receptions, and a conference banquet will be organized. EMTS 2019 will focus on electromagnetic fields and their applications. Contributions on any aspect of the scope of Commission B are solicited. Special-session topics will be listed later on the Web site. Authors will have their choice of submitting one-page abstracts that are not archived in IEEE Xplore, or two to four-page summaries that are archived on IEEE Xplore, if accepted and presented. All submissions will be reviewed by the Commission B Technical Advisory Board.

Important dates

- Paper submission site opens: July 15, 2018
- Deadline for paper submission: **October 22, 2018**
- Notification of acceptance: January 10, 2019
- Early-bird and author registration ends: March 30, 2019

Contact: Technical Program: Kazuya Kobayashi <kazuya@tamacc.chuo-u.ac.jp>
Local Organizing Committee: Sembiam Rengarajan <srengarajan@csun.edu>

List of Sessions

General Sessions

G01: Analytical and semi-analytical methods
G02: Canonical problems
G03: Integral equation methods
G04: Partial differential equation methods
G05: Fast solvers and high-order methods
G06: Time-domain techniques
G07: Computational algorithms
G08: Metamaterials and metasurfaces
G09: Plasmonics and nanoelectromagnetics
G10: Electromagnetic bandgaps and other periodic structures
G11: Optical devices
G12: EMC and EMI
G13: Bioelectromagnetics
G14: Antenna theory
G15: Antenna measurements
G16: Multi-band and wideband antennas
G17: Antenna arrays and MIMOs
G18: Wireless communication systems
G19: Guided waves and structures
G20: Random media and rough surfaces
G21: Millimeter-wave antennas
G22: MIMO for 5G communication

Convened Sessions

C01: Advanced algorithms in computational electromagnetics
Shinichiro Ohnuki (Nihon University, Japan)
Vladimir Okhmatovski (University of Manitoba, Canada)

This session will focus on most recent advances of numerical methods, numerical techniques, and their

applications in computational electromagnetics. Potential topics may include (but are not limited to):
- Fast, efficient, and accurate methods
- Recent advances in the integral equations of electromagnetics
- Numerical modelling and optimization
- Multiscale and multiphysics algorithms
- High performance computing and computer architecture
- Machine learning

C02: High-frequency wave propagation in highly disturbed ionosphere
Nikolay Zernov (St. Petersburg State University, Russia)
Vadim Gherm (St. Petersburg State University, Russia)

The session is aimed to discuss the analytic and numerical methods for treating the problems of the high-frequency wave propagation in the conditions of highly disturbed ionosphere. In particular, this includes the effects of meso-scale ionospheric structures as in the high-latitude, or equatorial ionosphere, which may be additionally associated with the effects of the field strong scintillation due to fluctuations of the electron density of the ionosphere. Adjacent problems of the high-frequency ionospheric propagation are also welcome.

C03: Inverse scattering and imaging
Lianlin Li (Peking University, China)
Matteo Pastorino (University of Genoa, Italy)

Electromagnetic wave techniques, both active and passive, have been gathering strong attention in sensing and imaging. They have found valuable applications in various areas including medical diagnostics, landmine detection, identification of intruders, finding human bodies in disaster events, vehicle collision avoidance, security checking at airports, etc. Used wavelength now ranges from radio to X-ray waves. One of recent driving forces is the use of UWB (Ultra Wideband) signals, which dramatically improves the range resolution, and thus extends the applicability of radar technique to targets with very short ranges, such as indoor and medical imaging. Many of these applications require super resolution and/or very fast computation in order to provide real time images with high quality and reliability. Advanced inverse scattering algorithms and imaging techniques are the key issues of the session. Theoretical investigations and studies aiming to other type of applications are of course welcome.

C04: Integral equation, hybrid, and fast Methods
Francesco Andriulli (Politecnico di Torino, Italy)
Thomas Eibert (Technical University of Munich, Germany)
Integral equation solutions provide very accurate and robust results of scattering, radiation and field transformation problems. Due to their global nature, they lead, however, in a straightforward solution approach to fully-populated operator equations, which in turn result in field solvers with a bad numerical complexity. Fast integral solvers aim at reducing the bad solution complexity and this can be achieved by a variety of different techniques. The focus of this session is primarily on integral equation formulations, discretization approaches, and corresponding hybrid methods as well as on fast iterative and direct solvers, which reduce the solver complexity of the operator equations in the context of radiation, scattering, or field transformation problems, where free-space or other Green's functions (as e.g. for layered media) are used. Improvements of existing techniques are as welcome as completely new approaches. The techniques can be based on purely algebraic, but also on physics motivated procedures. They can work in time-domain or in frequency domain, where low-frequency, high-frequency, and very wideband techniques are of interest.

C05: Novel mathematical methods in electromagnetics
Kazuya Kobayashi (Chuo University, Japan)
Yury Shestopalov (University of Gävle, Sweden)

This session will cover recent achievements in the area of advanced analytical and numerical methods as applied to various problems arising in all branches of electromagnetics. Topics of interest include, but are not limited to, the following areas: analytical regularization methods; canonical problems; computational electromagnetics; electromagnetic theory; gratings and periodic structures; guided waves; high-frequency techniques; integral equation methods; inverse problems; metamaterials; nonlinear phenomena; novel mathematical techniques; numerical methods; radar cross section; random media and rough surfaces; scattering and diffraction; time-domain techniques; waves in complex media; Wiener-Hopf technique.

C06: Mathematical modelling of EM problems
Paul Smith (Macquarie University, Australia)
Piergiorgio L. E. Uslenghi (University of Illinois at Chicago, USA)

This session will address recent developments in the mathematical modelling of electromagnetic problems by a variety of analytical, semi-analytical and numerical methods. Papers may consider significant modelling problems in any area of fields and waves including, for example, fundamental aspects of electromagnetic theory, material and media modelling, scattering and diffraction in the time or frequency domain, inverse problems and propagation. As appropriate, papers should discuss the analytical and/or numerical advantages of the chosen modelling framework over alternative approaches.

C07: Scattering and diffraction
Ludger Klinkenbusch (Kiel University, Germany)
Giuliano Manara (University of Pisa, Italy)

The session will review topics covering the wide range of scattering and diffraction. Methods and applications will be considered including asymptotic high-frequency methods, edge diffraction, surface waves, hybridization of numerical methods with high-frequency methods, and scattering from stochastic surfaces. Scattering from non-linear/anisotropic/dispersive media will also be emphasized. In addition, mathematical and analytical

methods for scattering and diffraction will be considered. Specific attention will be also given to different types of illuminating fields, such as plane waves, rays, and beams.

C08: Education in electromagnetics
Henrik Wallén (Aalto University, Finland)
Ari Sihvola (Aalto University, Finland)

Electromagnetics is a difficult topic to learn, and certainly also difficult to teach. Electromagnetics researchers have often very much expertise and silent knowledge about education. This session gathers together people who want to share their experiences in teaching electromagnetics. All types of contributions are welcome: case studies of individual courses, good practices in teaching physical concepts and phenomena, and electrical engineering education research results.

C09: History of electromagnetics
Ari Sihvola (Aalto University, Finland)
Henrik Wallén (Aalto University, Finland)

More than 150 years have passed since James Clerk Maxwell's unification of electric and magnetic phenomena into four quantitative laws that are today called Maxwell equations. The roots of understanding electricity and magnetism can be traced back to Ancient Greece, and the history of electromagnetism through centuries is a fascinating story. This session welcomes contributions on all aspects of the history of electromagnetics.

C10: Electromagnetic theory
Daniel Sjöberg (Lund University, Sweden)
Ben Steinberg (Tel Aviv University, Israel)

This session addresses the most recent advances in electromagnetic theory. It includes all aspects of electromagnetics, and all frequency ranges from statics to optics, including both time and frequency formulations. Of special interest are advances in mathematical modelling of complex structures and materials including aspects of periodicity and quasi-periodicity, topological aspects of ordered structures, solutions of canonical problems, analytic identities, guided waves, mathematical aspects of numerical methods, random and complex media, asymptotic methods, and antenna theory. Owing to the wide scope of EMTS and to the multi-disciplinary nature of contemporary research in electromagnetism, an extended view of the topics above is also welcome. This includes classical theories, as well as the incorporation of electromagnetism and quantum theory on the nano-scale. We expect contributions in this session to present unexpected phenomena, new paradigms or new interpretations of fundamental concepts, new solution methods, or to address questions with respect to well-posedness of different problems and models.

C11: Near-field coupling in wireless applications
Paolo Nepa (University of Pisa, Italy)
Andrea Michel (University of Pisa, Italy)

When talking about antenna design and propagation analysis, people usually think to wireless links between devices that are far apart, and this is actually the case in most of wireless applications. Nonetheless, there is a large number of wireless links where the antennas operate in their near-field region, either reactive or radiative. In such cases, conventional far-field coupling models based on plane-wave incidence approximation are not effective and more complex numerical and analytical models must be used. This special session aims to collect a number of wireless applications where proper electromagnetic models are required to account for the near-field coupling phenomena, as for example: wireless power transfer, microwave sensing with targets located in the antenna near-field region, chip-to-chip wireless links, electromagnetic compatibility issues, near-field antenna measurements and characterization, near-field communications, near-field radio frequency identification, near-field focusing.

C12: Materials in electromagnetics
Andrey Osipov (German Aerospace Center (DLR), Germany)
Paul Smith (Macquarie University, Australia)

The session will address the various aspects related to modelling and applications of materials, with an emphasis on theoretical and computer-aided methods and artificial (or engineered) materials.
The scope of the session will include the following areas:
(1) Electromagnetic properties, modelling and design of artificial materials.
(2) Scattering and propagation in the presence of artificial materials; approximate boundary conditions, reflection and transmission at interfaces of artificial materials (including FSS, metasheets and metasurfaces); canonical diffraction problems for finitely conducting (impedance, coated, dielectric, ferromagnetic, etc.) bodies.
(3) Applications of artificial materials to microwave absorbers, lenses, antenna radomes, cloaking, RCS reduction and EMI shielding.

C13: Analytical and canonical solutions for metamaterials and metasurfaces
Viktar Asadchy (Asadchy Viktar, Aalto University, Finland)
Ana Díaz-Rubio (Diaz Rubio Ana, Aalto University, Finland)
Sergei Tretyakov (Aalto University, Finland)

Exact or approximate analytical solutions of canonical problems are of key importance for electromagnetic theory. Creation of metamaterials and metasurfaces with exotic, extreme, and application-driven properties brings new challenges in finding analytical field solutions for full understanding and exploitation of electromagnetic phenomena in new materials. This convened session will discuss recent advances in analytical methods applied to metamaterial and metasurface structures.

C14: Waves in nonlinear media
Yury Shestopalov (University of Gävle, Sweden)

Eugen Smolkin (Penza State University, Russia)

The URSI EMTS 2019 session "Waves in nonlinear media" will cover recent achievements in the area of advanced analytical and numerical methods as applied to the analysis of wave propagation, scattering, and diffraction in nonlinear media. Topics of interest include, but are not limited to: development of mathematical models for fields and waves in nonlinear media; mathematical techniques for nonlinear equations of electromagnetics and analytical approaches; nonlinear phenomena and new types of waves; numerical methods for nonlinear problems.

C15: Exotic EM wave-matter interaction phenomena empowered by complex material platforms

Richard W. Ziolkowski (University of Technology Sydney, Australia)
Samel Arslanagić (Technical University of Denmark, Denmark)

Numerous recent advances of high relevance to the area of electromagnetic (EM) theory have been associated with research efforts in the field of wave-matter interactions empowered by and tailored with complex meta-material and meta-surface platforms. These efforts have furnished new and exciting solutions that have revealed truly novel EM properties for potential benefit in a variety of applications. They have also revived and extended many traditional EM radiation, scattering, and propagation analysis methods and placed them in the context of modern applications. To further advance the development of complex material platforms, we need to increase our fundamental understanding of their EM properties and how to exploit them. This special session is timely; it will cover the very recent analytical, numerical, and experimental research activities in this exciting research field while shedding light on its future directions.

C16: Forward scattering and propagation

Cristina Ponti ("Roma Tre" University, Italy)
Andrea Randazzo (University of Genoa, Italy)

The modelling of scattering problems by targets of arbitrary shape placed in possibly complex environments is in many cases a challenging task. However, the availability of accurate and reliable forward-scattering techniques is of fundamental importance both for propagation prediction and for providing benchmarks for novel inversion algorithms and imaging techniques, as well as for better understanding the measured data. Possible fields of applications include remote sensing of buried objects or detection and localization of targets behind walls. Beyond the radar applications, a significant interest has been recently devoted to the propagation modelling at high frequencies in a building's interior with UWB sources, including the scattering of common objects in an indoor environment. Possible approaches may include numerical full-wave techniques, also optimized from the point of view of computational times and memory requirements. High frequency asymptotic techniques are also of interest for addressing the computational issues relevant to very large environments. Analytical methods may be considered, too, when target geometry can be described through canonical shapes. In all cases, shadowing effects, attenuation, multipath propagation, refraction, and diffraction need to be considered for an accurate modelling, especially when dealing with complex scenarios.

C17: Antennas and microwave devices inspired by electromagnetic band gap

Karu Esselle (Macquarie University, Australia)
Ladislau Matekovits (Politecnico di Torino, Italy)

Several antennas and other microwave devices make use of EBG and many more have been inspired by EBG. In this session, we explore recent advances in this still exciting and advancing area of research.

C18: Recent advances in optimization techniques in electromagnetics

Sembiam R. Rengarajan (California State University, USA)
Ahmad Hoorfar (Villanova University, USA)

Nature-inspired and other novel global optimization techniques have been revolutionizing the design of complex electromagnetic devices with demanding specifications. This session will provide a forum for discussing advances in developments of optimization techniques and their wide ranging applications in electromagnetics.

C19: Millimeter-wave antennas/5G communications

John L. Volakis (Florida International University, USA)
Jiro Hirokawa (Tokyo Institute of Technology, Japan)

Millimeter wave applications have seen a growing number of applications from 5G beam forming to automotive guidance, security and imaging for biology. This session is focusing on antennas and antenna arrays, beamforming, MIMO and imaging technologies relating to millimeter wave applications. Applications relating to 5G, biology, automotive guidance, vehicle to vehicle communications, near zone high data delivery, imaging and security are of particular interest.

C20: Theory and applications of characteristic modes

Deb Chatterjee (University of Missouri at Kansas City, USA)
Ahmed M. Hassan (University of Missouri at Kansas City, USA)

Characteristic Mode Analysis (CMA) is an eigenfunction expansion of the currents on scatterers/antennas obtained through use of the well-known Method of Moments solution to the various electromagnetic integral equations under a special operator formalism. Current CMA areas of interest are (i) CMA of lossy objects, (ii) CMA of electrically large problems and the tracking of the numerous ensuing modes, (iii) CMA of scatterers in an inhomogeneous environment, (iv) CMA validations/standardization. This session solicits submissions in the previous areas in addition to any CMA

area related to the foundational theory, numerical techniques, and applications of CMA to antenna and scattering problems.

C21: High-frequency and hybrid methods
Prabhakar Pathak (Professor Emeritus at The Ohio State University and Adjunct Professor at University of South Florida, USA)
Giuliano Manara (University of Pisa, Italy)

This session focuses on high frequency methods, as well as hybrid methods which combine high frequency methods with other techniques to solve complex electromagnetic radiation and scattering problems, whose solutions may become cumbersome or intractable by the use of a single method alone. An example of such hybrid techniques is the combination of any asymptotic high frequency method with a numerical method. The asymptotic high frequency methods may include geometrical optics (GO), physical optics (PO), uniform theories of diffraction such as UTD, STD, PTD, or ITD, etc., or complex source beam (CSB) and Gaussian beam (GB) methods, etc., while numerical methods may be based on integral or partial differential equation formulations.

C22: International Union of Radio Science: 100 years of history and achievements of Commission B
Yahya Rahmat-Samii (University of California, Los Angeles (UCLA), USA)
W. Ross Stone (Stoneware Ltd., USA)
Ari Sihvola (Aalto University, Finland)

The International Union of Radio Science (URSI) was established in 1919 and will mark the centennial year in 2019. Commemorating the URSI 100 years in 2019, this session will focus on the history, the progress, and various achievements of URSI during the past 100 years, with a particular emphasis on URSI Commission B.

C23: Memorial session for Prof. Dennis P. Nyquist
Michael J. Havrilla (Air Force Institute of Technology, Wright-Patterson Air Force Base, USA)
George W. Hanson (University of Wisconsin-Milwaukee, USA)

This session honors the memory of Prof. Dennis P. Nyquist who was well known for his fundamental contributions in the areas of guided-wave and antenna theory, integrated electronics, wide band radar, material characterization, and radar target identification. Invited authors will present new research findings in these areas and will be given the opportunity to mention ways in which they may have collaborated with or have been influenced by Professor Nyquist.

C24: Electromagnetics at the nanoscale and quantum effects
Amir Boag (Tel Aviv University, Israel)
Amir Natan (Tel Aviv University, Israel)

The size of nanoscale devices makes it impossible to ignore quantum effects. Therefore, there is a growing demand for a theoretical treatment that combines classical electromagnetics and the quantum behavior of nanoscale systems. In this session, we invite theoretical and experimental researchers that work with such systems to present and discuss their work. Specific session topics will include (but not limited to): quantum transport, nano-antennas, nano-devices with quantum effects, and theory for electromagnetic simulations at the nano-scale.

C25: Advanced metamaterial concepts for electromagnetics
Andrea Alù (City University of New York, USA)
Dimitrios Sounas (Wayne State University, USA)

Metamaterials have attracted significant attention during the past decade for various exotic new phenomena and applications. Conventionally, they are based on passive and time-invariant elements, but it has recently been shown that lifting these assumptions may open new exciting opportunities for this technology, including parity-time symmetric, topological, computational and nonreciprocal metamaterials. The purpose of this session is to discuss the latest conceptual, theoretical and experimental advances in metamaterials, with a particular focus on metamaterials that go beyond the conventional passivity and time-invariance assumptions, or that combine multiple physical phenomena, for applications over different portions of the electromagnetic spectrum.

C26: Analytical methods in antennas, scattering and wave propagation
Ramakrishna Janaswamy (University of Massachusetts, Amherst, USA)
Satish K. Sharma (San Diego State University, USA)

With the availability of complex materials and surfaces in the design of antennas, RCS control, and guided wave propagation, further development of analytical techniques becomes important in the understanding of relevant devices. Analytical methods are also important in the understanding of electrically small antennas, new formulations of computational techniques directly involving potentials, and in waves propagating in open regions, to name a few. This session invites new contributions in the general area of analytical methods geared towards the study of antennas, radar cross section, guiding of waves and radiowave propagation.

C27: Chaos and complexity in electromagnetism
Gabriele Gradoni (University of Nottingham, UK)
Ari Sihvola (Aalto University, Finland)
Joe Wiart (Telecom ParisTech, France)

Statistical electromagnetics and wave chaos aim at characterizing and understanding the field propagation within complex circuits and environments. In particular, chaotic dynamics offers a unique platform for modelling wave systems with an arbitrary number of degrees of freedom. Recent studies in wave chaos have attracted researchers in electromagnetic theory and universal statistical properties have been used to study large electromagnetic systems. Circuits within printed circuit

boards are now modelled as complex statistical sources that can be treated through semiclassical as well as random matrix theories. Novel theoretical models have been developed describing fields through complicated electromagnetic environments – including electromagnetic reverberation chambers – also accounting for coupling through apertures and including losses at both microwave and mmWave regimes. New strategies are emerging to create hybrid methods combining those statistical methods with well-established full-wave techniques.

www.emts2019.org