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Higher Order Computational Electromagnetics, Uncertainty Quantification, and Meshing Techniques with Applications in Wireless Communication, Medicine, and Meteorology

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ABSTRACT

Electromagnetics-related, antenna, RF, microwave, radar, microelectronics, wireless, and lightwave, technologies are exploding! The importance of computational electromagnetics (CEM) to these technologies can hardly be overstated. This plenary talk presents some advances in several major components of CEM, including (1) higher order method of moments, finite element method, ray-tracing, and hybrid techniques, (2) uncertainty quantification techniques for CEM modeling of RF and microwave devices and systems featuring a posteriori error estimation, adaptive mesh refinement, and sensitivity analysis based on adjoint methods, and (3) automatic surface meshing in CEM by the discrete surface Ricci flow method enabling generation of high quality meshes and adaptive iterative mesh refinement. The talk also shows how these methodologies and techniques can be effectively applied to solving general real-world problems with impacts on wireless communication, medicine, and meteorology. The applications include (A) smart underground mining with an integrated wireless cyber-physical framework using CEM modeling and measurements of wireless propagation in underground mines, (B) design of RF coils for next-generation high and ultra-high field magnetic resonance imaging (MRI) scanners based on CEM and MRI experiments, and (C) accurate characterization of winter precipitation using multi-angle snowflake camera, visual hull image processing, advanced scattering methods, and polarimetric radar.

BIO

Branislav M. Notaroš received the Dipl.Ing. (B.S.), M.S., and Ph.D. degrees in electrical engineering from the University of Belgrade, Belgrade, Serbia, Yugoslavia, in 1988, 1992, and 1995, respectively. From 1996 to 1999, he was an Assistant Professor in the School of Electrical Engineering at the University of Belgrade. He spent the 1998-1999 academic year as a Visiting Scholar at the University of Colorado at Boulder. He was an Assistant Professor, from 1999 to 2004, and Associate Professor, from 2004 to 2006, in the Department of Electrical and Computer Engineering at the University of Massachusetts Dartmouth. From 2006 to 2012, he was an Associate Professor in the Department of Electrical and Computer Engineering at Colorado State University (CSU), where he is currently a Professor and University Distinguished Teaching Scholar, as well as Director of Electromagnetics Laboratory. His research publications include about 280 journal and conference papers. He is the author of textbooks "Electromagnetics" (Prentice Hall, 2010), "MATLAB-Based Electromagnetics" (Prentice Hall, 2013), and "Conceptual Electromagnetics" (CRC Press, 2017).

Dr. Notaroš is Fellow of the Institute of Electrical and Electronics Engineers (IEEE) and of the Applied Computational Electromagnetics Society (ACES). He serves as General Chair of the 2022 IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting and served as General Chair of the 2018 International Applied Computational Electromagnetics Society Symposium. He serves as President of ACES and Chair of the US National Committee Commission B of the International Union of Radio Science (URSI). He is Track Editor for the IEEE Transactions on Antennas and Propagation and the Meetings Committee Chair for the IEEE Antennas and Propagation Society (AP-S), and serves on the IEEE AP-S Administrative Committee. He was the recipient of the 2005 IEEE MTT-S Microwave Prize, 1999 IEE Marconi Premium, 2019 ACES Technical Achievement Award, 1999 URSI Young Scientist Award, 2005 UMass Dartmouth Scholar of the Year Award, 2012 CSU System Board of Governors Excellence in Undergraduate Teaching Award, 2014 and 2018 CSU Provost's N. Preston Davis Award for Instructional Innovation, 2012 IEEE Region 5 Outstanding Engineering Educator Award, 2014 Carnegie Foundation for the Advancement of Teaching Colorado Professor of the Year Award, 2015 American Society for Engineering Education ECE Distinguished Educator Award, and 2015 IEEE Undergraduate Teaching Award.