

Computational Electromagnetics using The Finite Difference Time Domain Method with Emphasis on Antenna Designs and their Interaction with Human Body

Atef Z. Elsherbeni

Professor, aelsherb@mines.edu

IEEE Fellow (2007) - ACES Fellow (2008)

IEEE APS Distinguished Lecturer (2020-2023)

Electrical Engineering Department, Colorado School of Mines

This presentation will focus on recent developments in the finite difference time domain (FDTD) method for the solution of several electromagnetic problems. Focused applications will include the design of antennas for wireless communication applications and the interactions of antenna radiations with the human body. First a brief introduction to the method, its capabilities, and the type of lumped circuit elements, linear and non-linear, which can be integrated into an electromagnetic simulation will be presented. Several examples of designing antennas, filters, and RFID tags will be demonstrated. This will be followed by the demonstration of how to integrate dispersive material analysis in the FDTD simulation. Medical applications will benefit from this integration. An example is the prediction of the field and temperature distribution inside a human head due to the radiation from a close by antenna or due to radiation from wearable antennas such as smart glasses. The speed up of the FDTD method using graphical processing gaming cards (GPUs) along with the use of different programming languages such as FORTRAN, MATLAB, CUDA, and OpenCL will be highlighted.



Atef Z. Elsherbeni received an honor B.Sc. degree in Electronics and Communications, an honor B.Sc. degree in Applied Physics, and a M.Eng. degree in Electrical Engineering, all from Cairo University, Cairo, Egypt, in 1976, 1979, and 1982, respectively, and a Ph.D. degree in Electrical Engineering from Manitoba University, Winnipeg, Manitoba, Canada, in 1987. He started his engineering career as a part time Software and System Design Engineer from March 1980 to December 1982 at the Automated Data System Center, Cairo, Egypt. From January to August 1987, he was a Post-Doctoral Fellow at Manitoba University. Dr. Elsherbeni joined the faculty at the University of Mississippi in August 1987 as an Assistant Professor of Electrical Engineering. He advanced to the rank of Associate Professor in July 1991, and to the rank of Professor in July 1997. He was the Associate Dean of the college of Engineering for Research and Graduate Programs from July 2009 to July 2013 at the University of Mississippi. He then joined the Electrical Engineering and Computer Science (EECS) Department at Colorado School of Mines in August

2013 as the Dobelman Distinguished Chair Professor. He was appointed the Interim Department Head for (EECS) from 2015 to 2016 and from 2016 to 2018 he was the Electrical Engineering Department Head. He spent a sabbatical term in 1996 at the Electrical Engineering Department, University of California at Los Angeles (UCLA) and was a visiting Professor at Magdeburg University during the summer of 2005 and at Tampere University of Technology in Finland during the summer of 2007. In 2009 he was selected as Finland Distinguished Professor by the Academy of Finland and TEKES.

Over the years, Dr. Elsherbeni participated in acquiring millions of dollars to support his research group activities dealing with scattering and diffraction of EM waves by dielectric and metal objects, finite difference time domain analysis of antennas and microwave devices, field visualization and software development for EM education, interactions of electromagnetic waves with human body, RFID and sensor Integrated FRID systems, reflector and printed antennas and antenna arrays for radars, UAV, and personal communication systems, antennas for wideband applications, and measurements of antenna characteristics and material properties. Dr. Elsherbeni is an IEEE life fellow and ACES fellow. He is the Editor-in-Chief for ACES Journal, and a past Associate Editor to the Radio Science Journal. He was the Chair of the Engineering and Physics Division of the Mississippi Academy of Science, the Chair of the Educational Activity Committee for IEEE Region 3 Section, and the general Chair for the 2014 APS-URSI Symposium and the president of ACES Society from 2013 to 2015. Dr. Elsherbeni is selected as Distinguished Lecturer for IEEE Antennas and Propagation Society for 2020-2023.