University of Illinois at Chicago, Electrical and Computer Engineering Department
IEEE Antennas and Propagation & Microwave Theory and Techniques Societies

Fast Algorithms and Parallel Computing: Solution of Extremely Large Integral Equations in Computational Electromagnetics

Levent Gürel, *Fellow of IEEE, ACES, and EMA*

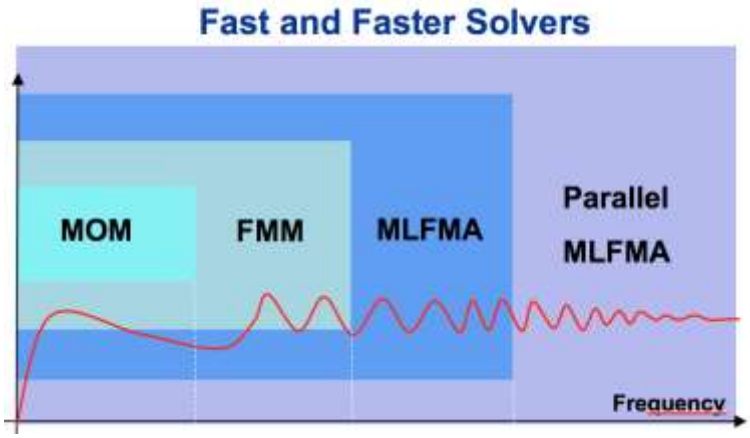
IEEE Distinguished Antennas and Propagation Lecturer
Professor, Dept. of Electrical and Electronics EngineeringDirector, Computational Electromagnetics Research Center (BiLCEM)
Bilkent University, Ankara, Turkey

Wednesday, September 18 at 11:00 AM

University of Illinois at Chicago
Department of Electrical and Computer Engineering
Room 1000, Science and Engineering Offices
851 South Morgan Street
Chicago, IL 60607

Host: Prof. Danilo Erricolo, derric1@uic.edu

Accurate simulations of real-life electromagnetics problems with integral equations require the solution of dense matrix equations involving millions of unknowns. Solutions of these extremely large problems cannot be achieved easily, even when using the most powerful computers with state-of-the-art technology. Some of the world's largest integral-equation problems in computational electromagnetics have been solved at Bilkent University Computational Electromagnetics Research Center (BiLCEM). Most recently, we have achieved the solution of 670,000,000x670,000,000 dense matrix equations! This achievement is an outcome of a multidisciplinary study involving physical understanding of electromagnetics problems, novel parallelization strategies (computer science), constructing parallel clusters (computer architecture), advanced mathematical methods for integral equations, fast solvers, iterative methods, preconditioners, and linear algebra.



In this seminar, following a general introduction to our work in computational electromagnetics, I will continue to present fast and accurate solutions of large-scale electromagnetic modeling problems involving three-dimensional geometries with arbitrary shapes using the multilevel fast multipole algorithm (MLFMA) and parallel MLFMA. Some of the complicated real-life problems (such as, scattering from a realistic aircraft) involve geometries that are larger than 1000 wavelengths. Accurate solutions of such problems can be used as reference data for high-frequency techniques. Solutions of extremely large canonical benchmark problems involving sphere and NASA Almond geometries will be presented, in addition to the solution of complicated objects, such as metamaterial problems, red blood cells, and dielectric photonic crystals. Solving the world's largest computational electromagnetics problems has important implications in terms of obtaining the solution of previously intractable physical, real-life, and scientific problems in various areas, such as (subsurface) scattering, optics, bioelectromagnetics, metamaterials, nanotechnology, remote sensing, etc. For more information: www.cem.bilkent.edu.tr.

BIOGRAPHY

Prof. Levent Gürel (*Fellow of IEEE, ACES, and EMA*) is the Director of the Computational Electromagnetics Research Center (BiLCEM) at Bilkent University, Ankara, Turkey. He received the M.S. and Ph.D. degrees from the University of Illinois at Urbana-Champaign (UIUC) in 1988 and 1991, respectively, in electrical and computer engineering. He joined the IBM Thomas J. Watson Research Center, Yorktown Heights, New York, in 1991. Since 1994, he has been a faculty member in the Department of Electrical and Electronics Engineering of the Bilkent University, Ankara, where he is currently a Professor, and a Visiting/Adjunct Professor at UIUC since 2003. Among the recognitions of Prof. Gürel's accomplishments, the two prestigious awards from the Turkish Academy of Sciences (TUBA) in 2002 and the Scientific and Technological Research Council of Turkey (TUBITAK) in 2003 are the most notable. He was conferred the UIUC ECE Distinguished Alumni Award in 2013. Prof. Gürel is currently serving as an associate editor of *Radio Science, IEEE Antennas and Wireless Propagation Letters (AWPL), JEMWA*, *PIER,* and *ACES Journals*. He was named an IEEE Distinguished Lecturer for 2011-2013 and invited to address the 2011 ACES Conference as a Plenary Speaker.