

Middle East Technical University
Department of Industrial Engineering
Seminar

Friday, May 2, 2008, 4:00 pm
IE Building, Blue Auditorium (Ground Floor)

Towards 100 Million Unknowns: Solving the World's Largest Dense-Matrix Problems in Computational Electromagnetics with Parallel Computing

Levent Gürel, PhD

Professor, Dept. of Electrical and Electronics Engineering
Director, Computational Electromagnetics Research Center (BiLCEM)
Bilkent University

Since 2006, the world's largest integral-equation problems in computational electromagnetics have been solved at Bilkent University Computational Electromagnetics Research Center (BiLCEM). Most recently, breaking the latest world record actually required the solution of 85,000,000x85,000,000 dense matrix equations! This achievement is an outcome of long and focused multidisciplinary study involving physical understanding of electromagnetics problems, advanced mathematical methods for integral equations, fast solution algorithms for electromagnetic problems, iterative methods for linear algebra, advanced preconditioners for iterative methods, novel parallelization strategies (computer science), and constructing parallel clusters (computer architecture).

In this seminar, following a general introduction to our work in computational electromagnetics, we 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). With an efficient parallelization of MLFMA, a wide variety of important real-life application problems that are discretized with tens of millions of unknowns are solved on clusters of computers built at BiLCEM, such as the 16-core, 32-core, 64-core and 128-core clusters with dual-core AMD Opteron and quad-core Intel Xeon processors interconnected via fast networks.

Levent Gürel received the B.Sc. degree in 1986 from the Middle East Technical University (METU) in electrical and electronics engineering. 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. He returned to the UIUC as a Visiting Professor in 2003-2005, and as an Adjunct Professor after 2005. He founded the Computational Electromagnetics Research Center (BiLCEM) at Bilkent University in 2005, where he is serving as the Director.

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 Technical Research Council of Turkey (TUBITAK) in 2003 are the most notable. Prof. Gürel is currently serving as an associate editor of *Radio Science* and *IEEE Antennas and Wireless Propagation Letters*.