



**BILKENT UNIVERSITY**

**unam** - INSTITUTE of MATERIALS SCIENCE & NANOTECHNOLOGY

***FACULTY OF SCIENCE***

**MATERIALS SCIENCE and NANOTECHNOLOGY  
GRADUATE PROGRAM SEMINAR**

**“Solutions of the World’s Largest Physical Problems in Computational Electromagnetics with Parallel Computing and Fast Algorithms”**

**Prof. Levent Gürel**

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Department of Electrical and Electronics Engineering  
Computational Electromagnetics Research Center, Director (BiLCEM)

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 550,000,000x550,000,000 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). Accurate solutions of real-life problems require discretizations with tens or hundreds of millions of unknowns. To achieve the solution of such extremely large problems, maximizing the computational resources by parallelizing MLFMA on distributed memory architectures is needed. However, due to its complicated structure, parallelization of MLFMA is not trivial. Recently, we proposed a hierarchical parallelization strategy to increase the efficiency of parallelization to enable the solution of electromagnetics problems with overall sizes in the orders of hundreds or thousands of wavelengths. 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 scattering, optics, bioelectromagnetics, metamaterials, nanotechnology, etc. For more information, please visit [www.cem.bilkent.edu.tr](http://www.cem.bilkent.edu.tr).

**Date : November 26, 2010 (Friday)**

**Time : 15:40**

**Place : Faculty of Science Building, A Block, Seminar Room (SA 240)**

**Tea will be served after the seminar**