



# Parallel MLFMA for the Solution of the World's Largest Integral-Equation Problems in Computational Electromagnetics: Towards 100 Million Unknowns

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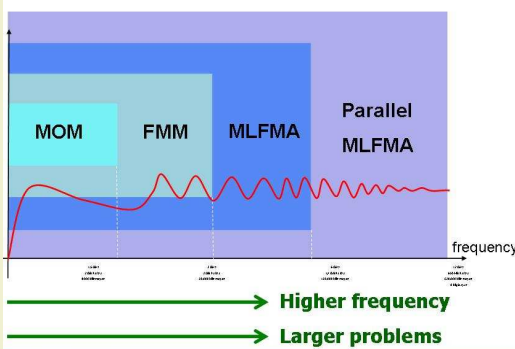
Date: May 9, 2008 (Friday)

Time: 17:30–18:30

Venue: Lecture Theatre A, Chow Yei Ching Building, HKU, Pokfulam Road

Registration: <http://engineering.hku.hk>

Fast and Faster Solvers



The multilevel fast multipole algorithm (MLFMA) [Chew *et al.*] provides fast and efficient solutions of computational electromagnetics problems involving large objects with three-dimensional arbitrary geometries. Accurate solutions of real-life problems require discretizations with tens 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, with which we have been able to solve the world's largest integral-equation problems in computational electromagnetics. 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 a multidisciplinary study involving physical understanding of electromagnetics problems, novel parallelization strategies (computer science), constructing parallel clusters (computer architecture), and advanced mathematical methods for integral equations, fast solvers, iterative methods, preconditioners, and linear algebra. For more information, please visit [www.cem.bilkent.edu.tr](http://www.cem.bilkent.edu.tr).

**Professor Levent Gürel** 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. He is also an Adjunct Professor at UIUC. 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*.

