

Title: A Review of Novel and Effective Preconditioners for Iterative and Parallel MLFMA Solvers

Speaker:

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Time: 10:30 am - 11:30 am

Venue: Room 204K, Chow Yei Ching Building

Abstract:

Solutions of extremely large matrix equations require iterative solvers. Multilevel fast multipole algorithm (MLFMA) accelerates the matrix-vector multiplications performed with every iteration. Despite the acceleration provided by MLFMA, the number of iterations should also be kept at a minimum, especially if the dimension of the matrix is in the order of millions. This is exactly where the preconditioners are needed. We have developed several novel preconditioners that can be used to accelerate the solution of various problems formulated with different types of integral equations. For example, it is well known that the electric-field integral equation (EFIE) is worse conditioned than the magnetic-field integral equation (MFIE) for conductor problems. Therefore, the preconditioners that we develop for EFIE are crucial for the solution of extremely large EFIE problems. For dielectric problems, we formulate several different types of integral equations to investigate which ones have better conditioning properties. Furthermore, we develop effective preconditioners specifically for dielectric problems. In this talk, we will review three classes of preconditioners:

1. Sparse near-field preconditioners
2. Approximate full-matrix preconditioners
3. Schur complement preconditioning for dielectric problems

I will present our efforts to devise effective preconditioners for MLFMA solutions of difficult electromagnetics problems involving both conductors and dielectrics, such as the blockdiagonal preconditioner (BDP), incomplete LU (ILU) preconditioners, sparse approximate inverse (SAI) preconditioners, iterative near-field (INF) preconditioner, approximate MLFMA (AMLFMA) preconditioner, the approximate Schur preconditioner (ASP), and the iterative Schur preconditioner (ISP).

For more information, please visit www.cem.bilkent.edu.tr.

Biography of the speaker:

Prof. Levent Gürel (Fellow, IEEE) 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. Prof. Gürel is currently serving as an associate editor of Radio Science, IEEE Antennas and Wireless Propagation Letters (AWPL), Journal of Electromagnetic Waves and Applications (JEMWA), and Progress in Electromagnetics Research (PIER). He is named an IEEE Distinguished Lecturer for 2011-2013 and invited to address the 2011 ACES Conference as a Plenary Speaker.

Organizer: Dr. L. Jiang