Joint Seminar of the IEEE Ottawa AP/MTT, CPMT, EMC Chapters and Department of Electronics, Carleton University

Time: 11:00am – 1:00pm

May 5 (Tue.), 2009

Location: Room 4124, Mackenzie Engineering Building, Carleton University

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Title: General-Purpose EM Solver (GEMS): A New Simulation Tool for Modeling Large-Scale Electromagnetic Systems on Parallel Platforms

Subtitle 1: Large-Scale Electromagnetic Systems Solving Techniques

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Subtitle 2: A 3-D High performance EM Simulation Tool: GEMS software and System

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Abstract

Given the recent trend whereby the designer of an EM device or a complex system thinks that it is imperative to carry out a “sanity check” before entering into the fabrication stage, a reliable and general-purpose EM solver has become highly-desired as well as invaluable part of the engineer’s toolkit. However, it is not uncommon for the designer to run into a roadblock when attempting to simulate many real-world

problems, due primarily to the inability of the available EM software modules to handle problems that require large number of degrees of freedom (DoFs), which can often run into billions. GEMS, a unique computer code which is recent entry into the EM software scenario, was originally developed under the sponsorship of the U.S. Navy, who needed to solve large and complex shipboard antenna problems, such as phased arrays with thousands of elements sharing a common platform, e.g., the mast of a ship, but found that the existing commercial softwares were highly inadequate in their ability to solve large problems that required a large number of DoFs to model them.

GEMS is a based on the parallel FDTD algorithm, and it has been designed to efficiently simulate large and complex EM problems using a group of distributed computers. Another desirable and unique feature of GEMS is that it provides a combination of EM software and hardware including network, operating system, I/O and storage, and optimized processors and memory. The talk will describe some of the features of GEMS, illustrated by numerous real-world examples that involve the simulation of large and complex EM problems, including antennas; antenna arrays; electronic packaging; RF and microwave circuits; bio-electromagnetics; and EMC/EMI, to name just a few.

Introduction to speakers:

Wenhua Yu is the president of 2COMU (main product is GEMS software and turnkey system) and a visiting professor of Pennsylvania State University. He has published over 100 technical papers and 4 books. The 5 serial articles published on IEEE Antennas and Propagation Magazine have established the foundation of parallel conformal FDTD software package development.

Selected published articles:

(1) Wenhua Yu, X. Yang, Y. Liu, Lai-Ching Ma, T. Su, N. Huang and R. Mittra, "New Direction in Computational Electromagnetics Solving Large Problems Using the Parallel FDTD on the BlueGene/L Supercomputer Yielding Teraflop-Level Performance", *IEEE Antennas and Propagation Magazine,* , Vol. 50, April 2008, No.23, pp. 20-42.

(2) Wenhua Yu, Yongjun Liu, Tao Su, and Raj Mittra, "A Robust Parallel Conformal Finite Difference Time Domain Processing Package Using MPI Library," *IEEE Antennas and Propagation Magazine*, Vol. 47, June 2005, No. 3, pp. 39-59.

(3) Tao Su, Yongjun Liu, Wenhua Yu and Raj Mittra, "A New Conformal Mesh

Generating Technique for Conformal Finite-Difference Time-Domain (CFDTD) Method," *IEEE Antennas and Propagation Magazine, Magazine*, Vol. 46, No.1, January 2004, pp.37-49.

(4) Wenhua Yu and Raj Mittra, "A Development Technique of Finite-Difference Time-Domain (FDTD) Software Package," *IEEE Antennas and Propagation Magazine* No.1, February 2003, pp.58-74.

(5) Wenhua Yu, Raj Mittra, "A Conformal FDTD Software Package for Modeling of Antennas and Microstrip Circuit Components,"*IEEE Antennas and Propagation Magazine*. Vol. 42, no. 5, pp. 28-39, October 2000.

Selected published books:

(1) *Conformal Finite Difference Time Domain Maxwell's Equations Solver, Software and User's Guide* , Artech House, Boston, Massachusetts, 2003.

(2) *Parallel Finite Difference Time Domain Method*, Artech House, Boston, Massachusetts, June, 2006.

(3) *Electromagnetic Simulation Techniques Based FDTD Method*, John Wiley and Sons, in press.

(4) *Advanced Computational Electromagnetics and Engineering Applications* (video book), Artech House, in press.

Raj Mittra is Professor in the Electrical Engineering department of the Pennsylvania State University. He is also the Director of the Electromagnetic Communication Laboratory, which is affiliated with the Communication and Space Sciences Laboratory of the EE Department. Prior to joining Penn State he was a Professor in Electrical and Computer Engineering at the University of Illinois in Urbana Champaign. He is a Life Fellow of the IEEE, a Past-President of AP-S, and he has served as the Editor of the Transactions of the Antennas and Propagation Society. He won the Guggenheim Fellowship Award in 1965, the IEEE Centennial Medal in 1984, the IEEE Millennium medal in 2000, the IEEE/AP-S Distinguished Achievement Award in 2002 and the AP-S Chen-To Tai Distinguished Educator Award in 2004. He has been a Visiting Professor at Oxford University, Oxford, England and at the Technical University of Denmark, Lyngby, Denmark. He has also served as the North American editor of the journal AEÜ.

He is the President of RM Associates, which is a consulting organization that provides services to industrial and governmental organizations, both in the U. S. and abroad.

His professional interests include the areas of Communication Antenna Design, RF circuits, computational electromagnetics, electromagnetic modeling and simulation of electronic packages, EMC analysis, radar scattering, frequency selective surfaces, microwave and millimeter wave integrated circuits, and satellite antennas.

He has published over 700 journal papers and more than 35 books or book chapters on various topics related to electromagnetics, antennas, microwaves and electronic packaging. He also has three patents on communication antennas to his credit. He has supervised 84 Ph.D. theses, 85 M.S. theses, and has mentored more than 50 postdocs and Visiting scholars. For the last 15 years he has directed, as well as lectured in, numerous short courses on Computational Electromagnetics, Electronic Packaging, Wireless antennas, both nationally and internationally.

These represent the most powerful general purpose solvers for high frequency simulation tasks. Additional solvers for specialist high frequency applications such as electrically large or highly resonant structures complement the general purpose solvers. CST Studio Suite includes FEM solvers dedicated to static and low frequency applications such as electromechanical devices, transformers or sensors. Alongside these are simulation methods available for charged particle dynamics, electronics, and multiphysics problems. Electromagnetic Simulation Magnetic and Electric Field Modeling Software. Trial Request. About EMS.Â Seamless integration with CAD geometry: EMS seamless integration in the two main CAD platforms â€“ SOLIDWORKS, and AutodeskÂ® InventorÂ® empowers you to simulate the most intricate electromagnetic designs. You don't need to "reinvent the wheel", just acquire a CAD model from the mechanical drafting personnel and start your electric or magnetic simulation instantly without any modification. Parametric simulation: EMS enables numerous What if? analyses to obtain the best design for your application. Any CAD dimension or a simulation variable can be set as a parameter to study the effe Generating EM Model and Symbol. Running EM Simulations. Viewing Simulation Summary.Â For a good antenna, a large part of the injected power is radiated, the rest will be lost. The loss is due to the presence of lossy materials (either the conductors or the dielectrics used) or gets trapped into the surface wave that propagates cylindrically along the substrate plane. The injected power is calculated from the S-parameters and the excitation sources (Thevenin sources) at the ports as specified by the user.Â A new Visualization window can be opened when far fields are calculated at another frequency. Note The Solution Setup and Plot Properties tabs have no association with the Far Field window. They apply to the surface current visualization on the Geometry window. This paper focus on a general-purpose FDTD-based solver, called general electromagnetic solver (GEMS), designed for modeling and simulating a wide variety of large-scale electromagnetic problems, involving microwave circuits, RF and digital electronic packages, as well as open region radiation and scattering problems. We begin by observing that there is a rapidly growing trend in computational electromagnetics (CEM) that is significantly impacting the computing landscape, namely the use of highly-parallel computers to address large and complex problems. Do you want to read the rest of this con