Computational Electromagnetics Spring 2011

Class meets TTh 3:30-5:00pm at ENS 306 EE383V-Unique No. 17102

Instructor
Ali Yilmaz
Office Hours: TBD (See blackboard)

Course webpage

Blackboard (http://courses.utexas.edu)

Textbook and Supplements

J. Jin, *The Finite Element Method in Electromagnetics*, 2nd edition, Wiley, 2002.

A. Taflove and S. Hagness, *Computational Electrodynamics: The Finite Difference Method*, Artech House, Third Edition, 2005.

A. F. Peterson, S. L. Ray, and R. Mittra, *Computational Methods for Electromagnetics*, Wiley-IEEE Press, 1997.

D. B. Davidson, *Computational Electromagnetics for RF and Microwave Engineering*, Cambridge University Press, 2005.

Prerequisites

EE 383L or equivalent.
Familiarity with a high level programming language: C, Fortran, Matlab, …

Grading

Homework (~ 5)		10%
Team Projects		
1st project (FDTD)	Code+paper	20%
2nd project (FEM)	Code+paper	25%
3rd project (MOM)	Code+paper	25%
Project Presentations		20%

Course Objectives

The objective of this course is to develop fundamental electromagnetic modeling and analysis skills for research applications in the areas of antenna design, electromagnetic interference, stealth technology, biomedical engineering, microwave circuits, and geophysics. The course emphasizes problem formulation, numerical techniques, and computer implementation. Team projects cover differential and integral equation based computational electromagnetics methods in frequency and time domains.

Projects

The projects require numerical solution of electromagnetics problems using codes *developed* by teams of students. Teams are expected to turn in *operational codes* and *journal quality papers* that present their results. The project grading will be based on the following questions:

1) Is the code operational?
2) Are the results "correct"?
3) What is the quality of the paper? (Writing, organization, results, claims, references)

The team members will have the *same grades for codes and papers*. Each project will be presented by a different student; *the presentations will be individually graded*.

Other Information

Copying other people's work or letting others copy your work is considered scholastics dishonesty and will not be tolerated under any circumstances.

The course and instructor evaluation will be made during the last week of class.

The University of Texas at Austin provides, upon request, appropriate academic adjustments for qualified students with disabilities.

Tentative Course Outline

1. Review of Electromagnetic Theory

Maxwell's equations, boundary conditions, vector and scalar potentials, radiation condition, Huygens' principle, radar cross section

2. Basics of Scientific Computing

Numerical error, convergence, interpolation, extrapolation, numerical integration, numerical differentiation, direct and iterative matrix equation solvers

3. Finite Difference Method

Finite difference frequency domain, FDTD, absorbing boundary conditions, perfectly matched layers

4. Finite Element Method

Galerkin and Rayleigh-Ritz methods, variational formulation, higher-order elements

5. Method of Moments

Surface and volume equivalence principles, wire, surface, and volume integral equations, frequency- and time-domain formulations

6. Advanced Topics

Fast algorithms (FFT and FMM based), hybrid methods, finite-element boundary-integral methods