ECE 837: Computational Electromagnetics and Acoustics
Fall 2012;

Instructors: Prof. Shanker Balasubramaniam
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Office Hours: By appointment–typically any day
Recommended Text: Computational Methods in Electromagnetics, A. F. Peterson, S. Ray and R. Mittra, IEEE Press. I will attempt to provide notes! All of these will be uploaded on Angel!
Suggested Books:

1. Field Computation by Method of Moments, R. F. Harrington, IEEE Press
2. Finite Element Methods in Electromagnetics, J. Jin, Wiley
3. Finite Difference Time Domain, Kunz and Luebbers
4. Finite Element Methods for Electromagnetics, J. Volakis, A. Chatterjee, and L. Kempel, IEEE Press.
5. Other books on Finite element methods — Brenner & Scott, Monk

Class Policies

1. **Homework** Some homeworks will be assigned.
2. Projects + presentation; There will be three class projects and a presentation of your work in class. These projects will be assigned on an individual basis, and can span all aspects of EM and others.
3. **Grade Distribution**
   - Homework: 25%
   - Projects: 75%

Tentative Course Outline:

1. Review of electromagnetics
   (a) Importance of computational methods
   (b) Fundamental theorems and principles in electromagnetics
   (c) Auxiliary potentials and construction of solutions
   (d) Introduction to Greens functions
   (e) Introduction to linear spaces, basis functions, and interpolation
   (f) Introduction to operators in electromagnetics
2. Finite Difference Methods
   (a) Solving a simple 1-D equation using finite differences
   (b) 1-D scalar equations
   (c) Stability and dispersion characteristics of such systems
   (d) 2-D equations; Laplace and Poisson systems
   (e) Boundary conditions; Matrix solutions and Iterative solvers

(f) 2-D Helmholtz equations
(g) Yee-cell
(h) Absorbing boundary conditions
(i) Perfectly matched layers
(j) 3-D Helmholtz equations

3. Integral equations

(a) Basis functions
(b) Greens theorems and integral equations
(c) Greens function for the Helmholtz equation in 2 and 3 dimensions
(d) Kinds of integral equation operators
(e) Construction of solutions in 1-D;
(f) Basis functions in 2-D space
(g) Construction of solutions in 2-D
(h) Electric and magentic field integral equations
(i) Uniqueness of solutions and the combined field/source integral equation.
(j) Construction of solutions in three dimensions

4. Finite Element Methods

(a) Variational formulation
(b) Basis function (highlight differences from that used for IE)
(c) Scalar wave equation
(d) Construction of matrix systems
(e) Imposition of boundary conditions
(f) Vector elements
(g) Construction of matrix systems
(h) Imposition of boundary conditions
(i) Advanced topics