MA690: Introduction of Finite Element Methods for Maxwell's Equations

Instructor: Prof. Peijun Li, office: Math 440, phone: 49-40846, e-mail: `lipeijun@math.purdue.edu`

Time: TTh 12:00-1:15 pm

Room: MATH 211

Office hour: TTh 10:00-11:00 am

Course website

`www.math.purdue.edu/~lipeijun/math690.html`

Prerequisite: Basic knowledge of functional and numerical analysis, and partial differential equations.

Description: Over the last two decades, the dramatic growth of computational capability and the development of fast algorithms have transformed the methodology for scientific investigation and industrial applications in the field of computational electromagnetism. Reciprocally, the practical applications and scientific developments have driven the need for more advanced mathematical models and numerical methods to describe the scattering of complicated structures, and to compute electromagnetic fields and thus to predict the performance of a given structure, as well as to carry out optimal design of new structures. The aim of this course is to provide an up-to-date and sound theoretical foundation for finite element methods in computational electromagnetism. The emphasis is on finite element methods for a class of scattering problems that involve the solution of Maxwell's equations.

The course is intended to be self-contained and will provide introductory material to the areas in electromagnetism that offer rich and challenging mathematical problems. Tentative topics will include: Sobolev spaces, conforming finite edge elements, variational formulations, finite element approximations, adaptivity with a posterior error estimates, perfectly matched layer techniques, and inverse scattering. As applications, the following problems will be covered: biperiodic grating problem, cavity scattering problem, exterior or open domain scattering problem, unbounded rough surface scattering problem, and inverse medium scattering problem.

Text: No textbook is required. Lecture notes will be made available to students.

Course grade: No exams. Students are required to present course-related material in class.

References:

1. P. Monk, *Finite Element Methods for Maxwell's Equations*
2. J. Jin, *The Finite Element Method in Electromagnetics*
3. J.-C. Nédélec, *Acoustic and Electromagnetic Equations: Integral Representations for Harmonic Problems*
4. D. Colton and R. Kress, *Inverse Acoustic and Electromagnetic Scattering Theory*