Numerical Solution of Partial Differential Equations– Finite Element Method

Spring, 2019, MA587

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The Finite Element Method is one of very important and powerful numerical methods for solving partial differential equations in science and engineering. In this course, we develop the theoretical foundation and algorithm. First, we will introduce the method for one-dimensional problems so that we can learn the essential tools that carry over to higher dimensions. Topics include elliptic equations and elliptic system (Elasticity, Maxwell′s equations), parabolic (heat equations), wave equations and Navier Stokes system and hyperbolic equations (Conservation laws and Hamilton Jacobi equation). Essential tools are the weak formulation and Galerkin methods, the function space approximation theory (basic finite element spaces). We study the stability analysis and the convergence and error analysis. The students will be able to implement finite element methods using sample Matlab codes.

- Basic Finite element method and Advanced methods.
- Theoretical Foundation of Finite Element Methods.
- Weak formulation and Convergence analysis.
- Discontinuous Galelkin methods.
- Specific Topics (Request is considered).

A good learning environment is essential to the success of a class and Grade is based on:

- Homework (analytic part and computer projects) about every two weeks: 30%
- Two take-home tests: 60% (time to be announced)
- Class participation and Quiz 10% (Essential for Study and good grade)

Reference Text:

Numerical Solutions of Partial Differential Equations. An Introduction to Finite Difference and Finite Element Methods under contract, Cambridge by Prof. Li.

Office Hours: TTh 1:00-2:00 p.m., otherwise Appointment.