UNIVERSITY OF NEBRASKA AT OMAHA

MATH 4400/8406: Finite Element Methods for Ordinary and Partial Differential Equations

MW 7:00 PM – 8:15 PM | Dr. Baccouch

Introduction: The finite element method (FEM) is a numerical technique for computing approximate solutions to complex mathematical problems described by differential equations. The method was developed in the 1950s to solve complicated problems in engineering, notably in elasticity and structural mechanics modeling. But, nowadays the range of applications is quite extensive. In this course, we introduce the FEM as a general method for approximating solutions of ordinary differential equations (ODEs) and partial differential equations (PDEs).

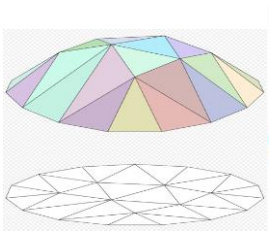
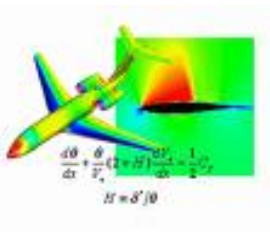
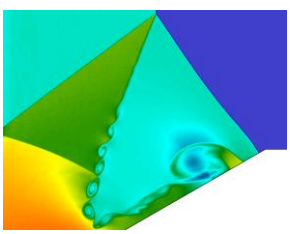
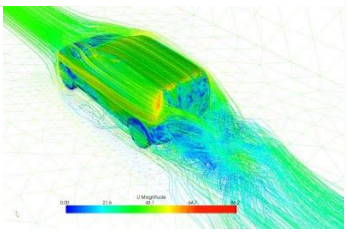
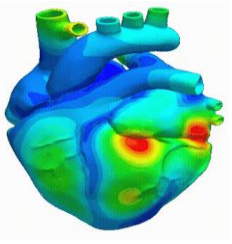
Course Description: You will learn the basic knowledge of the theory, practice, and implementation of the FEM for ODEs and PDEs arising in physics and engineering sciences. The main purpose is to give a balanced combination of theoretical and practical skills. We will introduce the FEM as a general method for solving differential equations. We will emphasize implementation of the involved algorithms, and have mixed mathematical theory with concrete computer code using the numerical software MATLAB and its PDE-Toolbox.

Style of course: For each type of differential equations covered in this course, we will introduce the corresponding FEM step by step in a unified framework, which will eventually provide a unified finite element package for all types of differential equations. Starting from the mesh generation and the construction of the finite element basis functions, we will derive the weak formulation, discretization formulation, and matrix formulation, discuss the advantages and disadvantages and the implementation issues, have guided coding practice, and carry out the numerical analysis in class. Applications of these methods will be also discussed. After class, the homework (mixture of written and programming) will provide you opportunities to apply the FEMs and analysis you learn in class and the code you obtain through the guided coding.

Prereq: MATH 1970, MATH 2050, and MATH 2350, or instructor's permission. MATH 3300 and MATH 4330 are recommended, but not required.

Software: You may use any programming language. In class I will use MATLAB. Familiarity with MATLAB programming is not required. With considerable effort, you could learn MATLAB while taking the course.

Textbook: Larson and Bengzon, The Finite Element Method: Theory, Implementation, and Applications, Springer, 2013. ISBN 978-3-642-33286-9

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