Course Syllabus

Jump to Today Edit

We will begin with ODE solvers applied to both initial and boundary value problems. Our application will be to find the eigenstates of a quantum mechanical problem or of an optical waveguide.

We will introduce the idea of finite-differencing of differential operators. Our application will be to two problems: vibrating modes of a drum and the evolution of potential vorticity in an advection-diffusion problem of fluid mechanics.

Transform methods for PDEs will be introduced with special emphasis given to the Fast-Fourier Transform. We will revisit the potential vorticity in an advection-diffusion problem of fluid mechanics by using these spectral techniques.

For subtle computational domains, the use of a finite element scheme is compulsory. The steady-state flow of a fluid over various airfoils will be considered.

(1) Solution Methods for Differential Equations: (2 weeks)

(a) Initial value problems
(b) Euler method, 2nd- and 4th-order Runge-Kutta, Adams-Bashford
(c) Stability and time stepping issues
(d) Boundary values problems: shooting/collocation/relaxation

(2) Finite Difference Schemes for Partial Differential Equations: (3 weeks)
(a) Collocation
(b) Stability and CFL conditions
(c) Time and space stepping routines
(d) Tri-diagonal matrix operations

(3) Spectral Methods for Partial Differential Equations: (3 weeks)
(a) The Fast-Fourier transform (FFT)
(b) Chebychev transforms
(c) Time and space stepping routines
(d) Numerical filtering algorithms

(4) Finite Element Schemes for Partial Differential Equations: (2 weeks)
(a) Mesh generation
(b) Advanced matrix operations
(c) Boundary conditions

Course Summary:

Date	Details	
Wed Sep 30, 2020	AMATH 481 A Au 20: Scientific Computing (https://canvas.uw.edu/calendar?event_id=1666677&include_contexts=course_1395356)	9:30am to 10:15am