

Introduction to Week Six

Numerical Solutions of PDEs

Direct Solution of Boundary Value Problems

Iterative Solution of Boundary Value Problems

Time-stepping Methods for Initial Value Problems

- ✓

Video: Explicit Methods for Solving the Diffusion Equation | Lecture 69
13 min
- ✓

Reading: Using a Second-Order Time-Stepping Method
10 min
- ✓

Reading: FTCS Scheme for the Advection Equation
10 min
- ✓

Video: Von Neumann Stability Analysis of the FTCS Scheme | Lecture 70
14 min
- ✓

Reading: Von Neumann Stability Analysis of the FTCS Scheme for the Advection Equation
10 min
- ✓

Video: Implicit Methods for Solving the Diffusion Equation | Lecture 71
8 min
- ✓

Reading: Implicit Discrete Advection Equation
10 min
- ✓

Video: Crank-Nicolson Method for the Diffusion Equation | Lecture 72
13 min
- ✓

Reading: Lax Scheme for the Advection Equation
10 min
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Video: MATLAB Solution of the Diffusion Equation | Lecture 73
11 min
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Reading: Difference Approximations for the Derivative at Boundary Points
1 min
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Ungraded External Tool: The Diffusion Equation with No-Flux Boundary Conditions
30 min

Quiz

Programming Assignment: Two-dimensional Diffusion Equation

Farewell

Lax Scheme for the Advection Equation

Consider the one-dimensional advection equation given by

$$\frac{\partial u}{\partial t} = -c \frac{\partial u}{\partial x}.$$

The explicit Lax scheme for the advection equation is given by

$$u_j^{l+1} = \frac{1}{2}(u_{j+1}^l + u_{j-1}^l) - \frac{c\Delta t}{2\Delta x}(u_{j+1}^l - u_{j-1}^l).$$

Analyze its stability and derive the Courant-Friedrichs-Lewy (CFL) stability criterion, which is widely used in fluid turbulence simulations.

✓ Completed

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