

Computer Assignment 01: Numerical and Analytical Solutions to Parabolic Partial Differential Equations: prerequisite for solving boundary layer problems

1. Description of the Problem:

Given the following second order linear parabolic partial differential equation (PDE):

$$\frac{\partial u}{\partial x} - 2 \frac{\partial^2 u}{\partial y^2} = 2 \quad (1)$$

with boundary conditions: $u(x, 0) = 0$, $u(x, 1) = 0$, and initial condition: $u(0, y) = 0$, our objectives were to:

1. Derive the analytical solution of the parabolic equation with its given initial and boundary conditions.
2. Use the Crank-Nicolson scheme and central difference scheme to discretize the equation (using either a finite-volume or a finite-difference based method).
3. Find the numerical solution of the parabolic equation and compare it with the analytical solution using LU decomposition as the linear system solver.

The results of these objectives will be of use for further projects, as parabolic partial differential equations like the one above can be used to describe heat conduction and viscous boundary layers.

2. Derivation of the Analytical Solution:

TBD

3. Description of the Numerical Method:

TBD

4. Presentation of Results:

4.1. Profiles at different x locations from numerical solution

TBD

4.2. Profiles at different x locations from analytical solution

TBD

5. Discussion of Results:

5.1. General description

TBD

5.2. Accuracy and stability

TBD

6. Appendix - Copy of Program Listing:

6.1. Structure

TBD

6.2. Documentation

TBD