



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
DEPARTMENT OF MECHANICAL ENGINEERING
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ME 543 Computational Fluid Dynamics
Computer Assignment – 2

Solve the following non-dimensional partial differential equation for **Couette Flow** using finite difference method with specified boundary conditions for $j=1$ to $j=101(M)$ grid size as shown in Fig. 1. Use **pseudo-transient** solution approach **with initial condition of u -velocity as zero**.

$$\frac{\partial u}{\partial t} = \frac{1}{Re_H} \frac{\partial^2 u}{\partial y^2} \quad Re_H = \frac{UH}{\nu} \quad \epsilon = \sqrt{\frac{\sum_{j=1}^M (u^{n+1} - u^n)^2}{M}}$$

1. Explicit method : **FTCS**
2. Implicit method
 - a) **BTCS**: Gauss-Seidel iterative method
 - b) **BTCS**: TriDiagonal Matrix Algorithm
 - c) **Crank-Nicolson**: TriDiagonal Matrix Algorithm

Discretize the above PDE using the discretization schemes mentioned above with uniform grid of M . Take $Re_H=100$ and $\Delta t = 5 \times 10^{-3}$ for Explicit method and $\Delta t = 10^{-2}$ for Implicit method.

Submit results in terms of velocity profiles at different time* including steady state results as shown in Fig. 2, **convergence history (ϵ vs t)** for all schemes in a single plot and report on discretized algebraic equation of each discretization scheme, comparison study of number of time iterations and physical time taken to converge up to $\epsilon < 10^{-6}$.

***FTCS**: $t=0.5, 2.5, 10, 25$, converged result and **Crank-Nicolson**: $t=1, 5, 10$, converged result

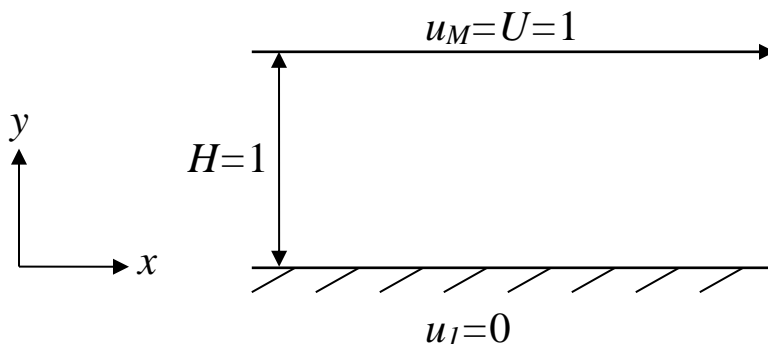


Fig. 1

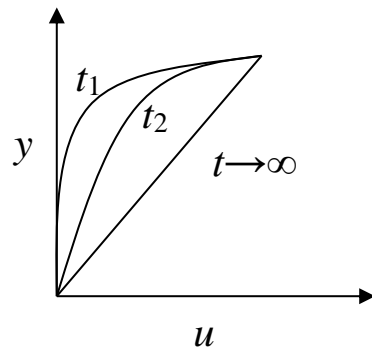


Fig. 2