

Explicit method: FTCS

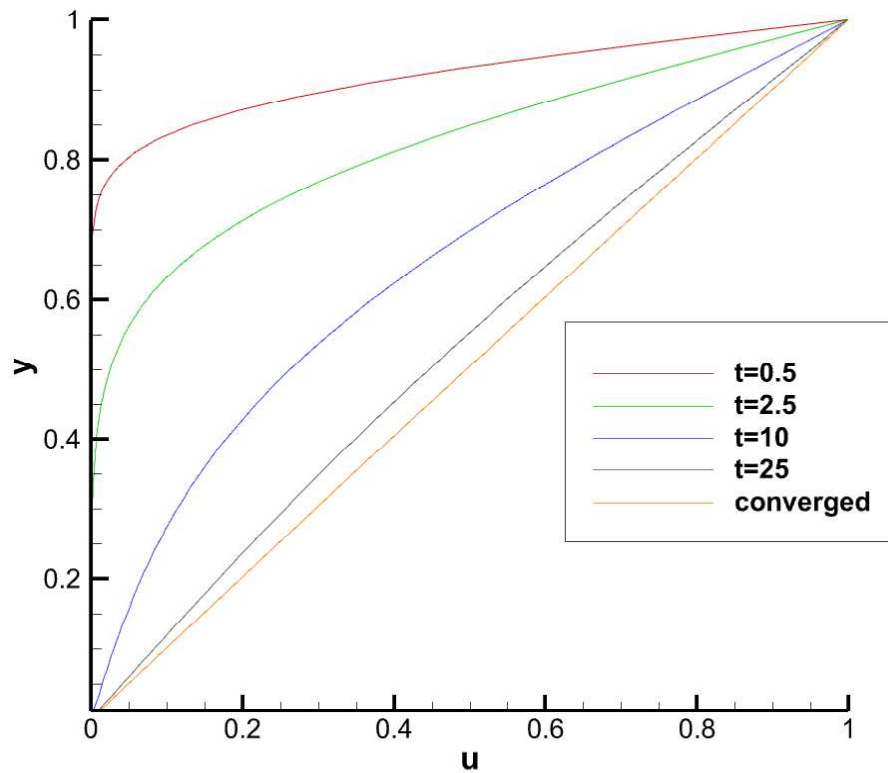
Discretization:

$$\frac{u_i^{n+1} - u_i^n}{\Delta t} = \frac{1}{Re_h} \frac{u_{i+1}^n - 2u_i^n + u_{i-1}^n}{\Delta y^2}$$

$$u_i^{n+1} = u_i^n + \gamma(u_{i+1}^n - 2u_i^n + u_{i-1}^n)$$

$$u_i^{n+1} = u_i^n(1 - 2\gamma) + \gamma u_{i+1}^n + \gamma u_{i-1}^n$$

Velocity profile:



BTCS:

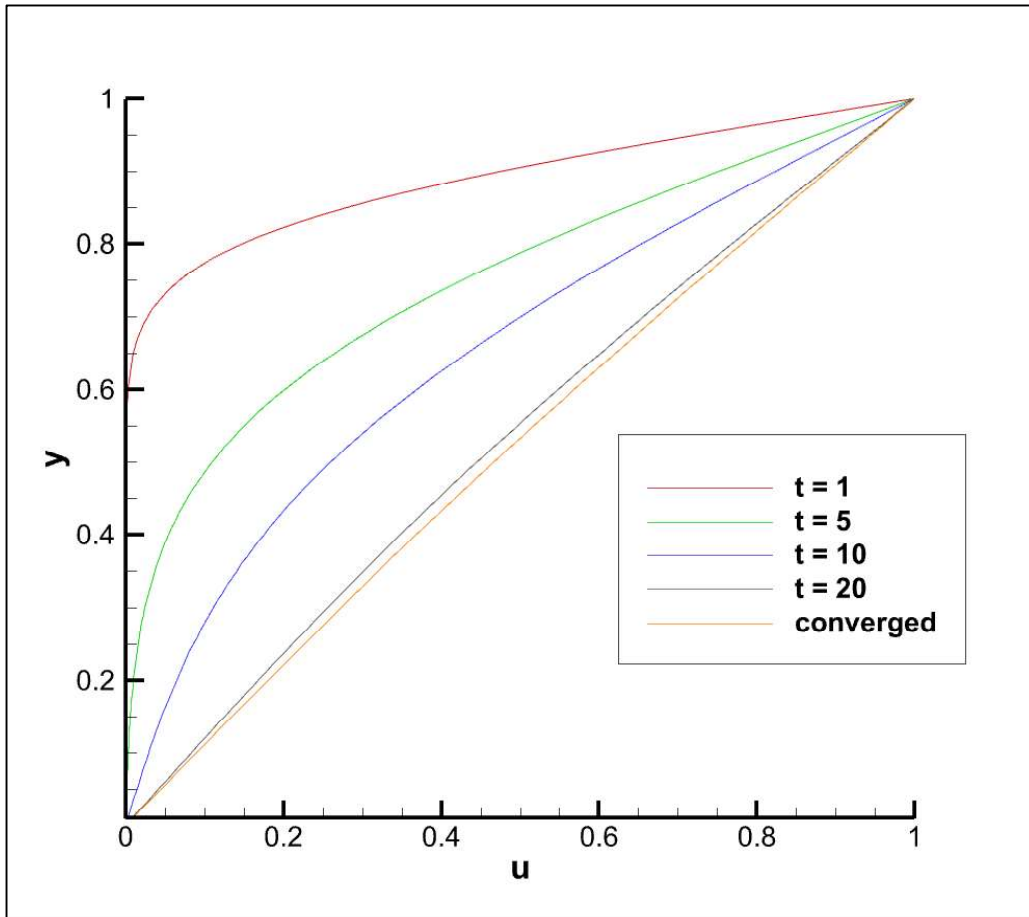
Discretization:

$$\frac{u_i^{n+1} - u_i^n}{\Delta t} = \frac{1}{Re_h} \frac{u_{i+1}^{n+1} - 2u_i^{n+1} + u_{i-1}^{n+1}}{\Delta y^2}$$

$$u_i^{n+1} = u_i^n + \gamma(u_{i+1}^{n+1} - 2u_i^{n+1} + u_{i-1}^{n+1})$$
$$-u_i^{n+1}(1 + 2\gamma) + \gamma u_{i+1}^{n+1} + \gamma u_{i-1}^{n+1} = -u_i^n$$

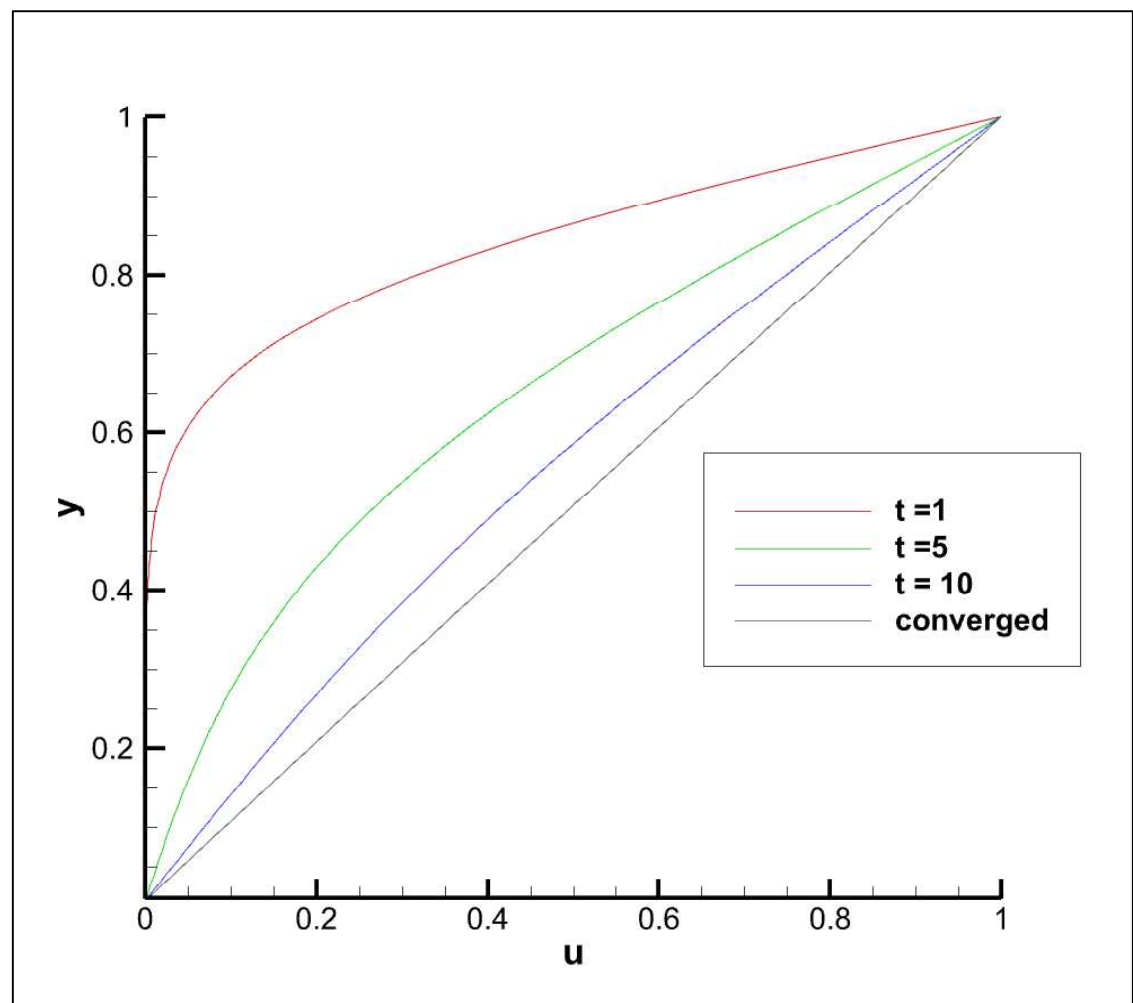
BTCS: Gauss-Seidel iterative method

Velocity profile:



BTCS: Tridiagonal Matrix Algorithm

Velocity profile:



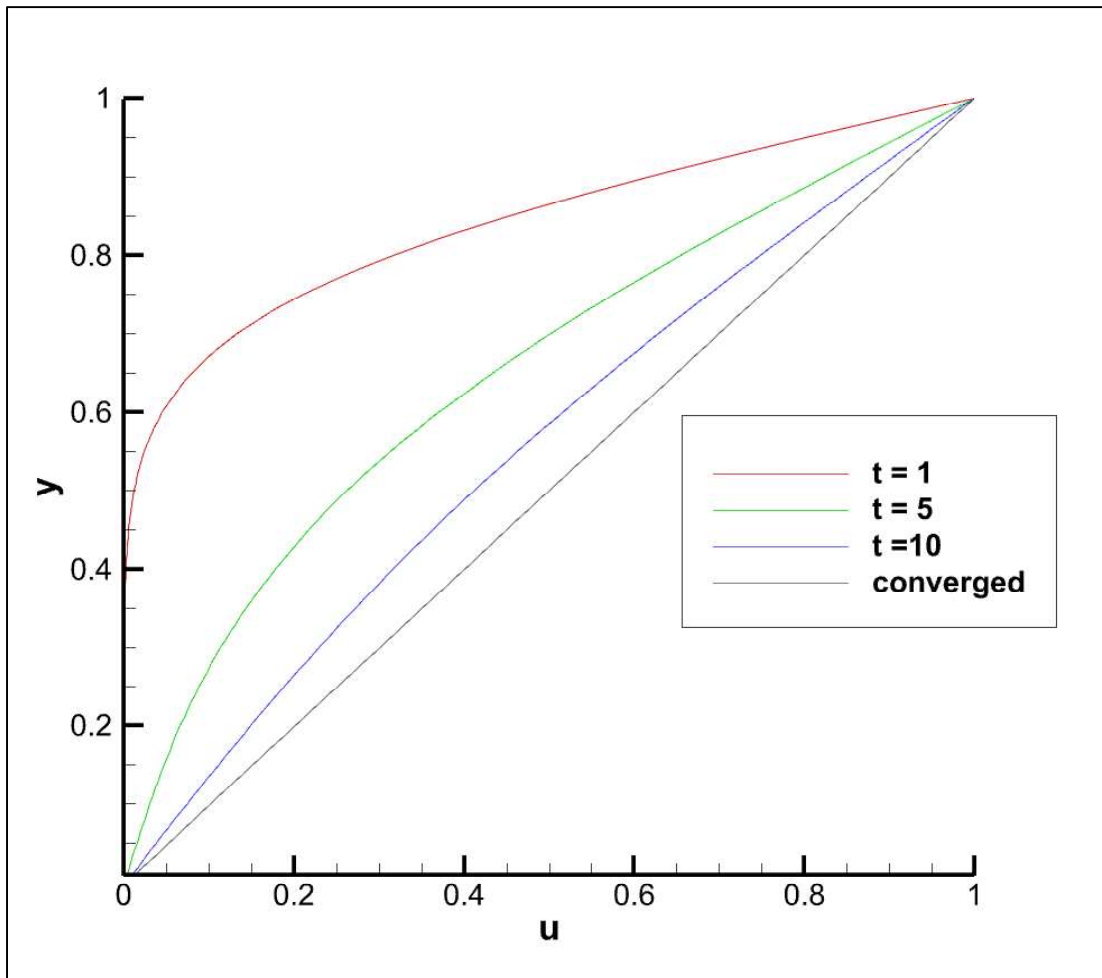
Crank-Nicolson: Tridiagonal Matrix Algorithm

Discretization:

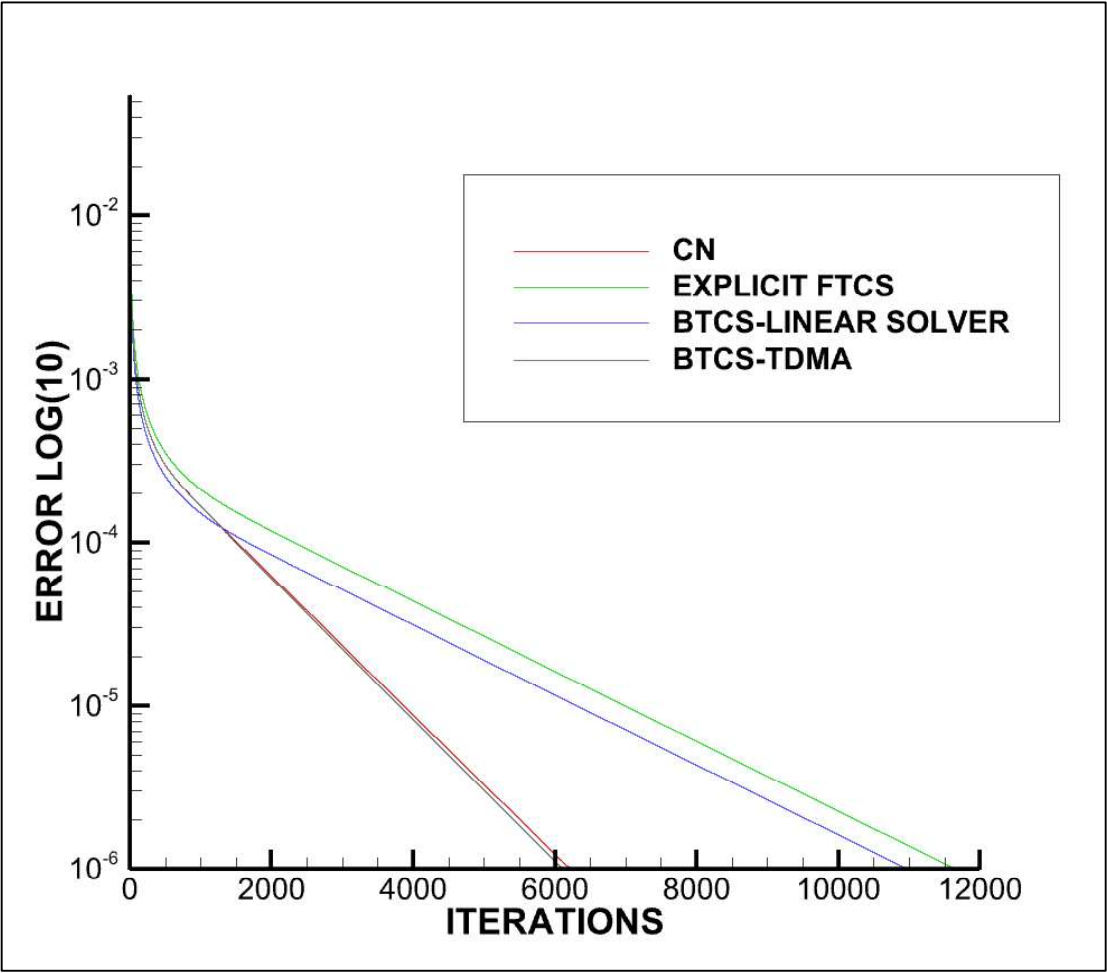
$$u_i^{n+1} - u_i^n = \frac{\gamma}{2} [u_{i+1}^{n+1} - 2u_i^{n+1} + u_{i-1}^{n+1} + u_{i+1}^n - 2u_i^n + u_{i-1}^{n+1}]$$

$$u_i^{n+1}(1 + \gamma) - \frac{\gamma}{2} u_{i+1}^{n+1} - \frac{\gamma}{2} u_{i-1}^{n+1} = u_i^n(1 - \gamma) + \frac{\gamma}{2} u_{i+1}^n + \frac{\gamma}{2} u_{i-1}^n$$

Velocity profile:



Error vs Iterations:



Time vs Error:

