Project 8 - SF2520

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Problem description

Blabla

bla

1 dimension

1) on explique la discretisation
2) on explique que sauf pour le first step, on a

$$f(U) = A * U$$

et on défini la matrice A. Cela because en gros

For any index t,

$$\begin{aligned} f(U_i) &= \frac{\nu}{r_i}\frac{(U_{i+1} - U_{i-1})}{h_x} + \nu\frac{U_{i+1} - 2U_i + U_{i-1}}{h_x * h_x} - \frac{\nu}{r_i^2}U_i \\ &= \frac{\nu}{h_x}\Big(\frac{1}{h_x} - \frac{1}{r_i}\Big)U_{i-1} - \nu\Big(\frac{2}{h_x^2} + \frac{1}{r_i^2}\Big)U_i + \frac{\nu}{h_x}\Big(\frac{1}{h_x} + \frac{1}{r_i}\Big)U_{i+1} \end{aligned}$$

So we can now write the Crank-Nicolson method as

$$\begin{aligned} U^{t+1} &= U^t + 0.5 * h_t\Big(f(U^t) + f(U^{t+1})\Big) \\ &= U^t + 0.5 * h_t\Big(A * U^t + A * U^{t+1}\Big) \end{aligned}$$

Therefore,

$$\Big(Id - 0.5 * h_t * A)U^{t+1} = (Id + 0.5 * h_t * A)U^t$$

This is a linear system that can easily be solved for U^{t+1}.

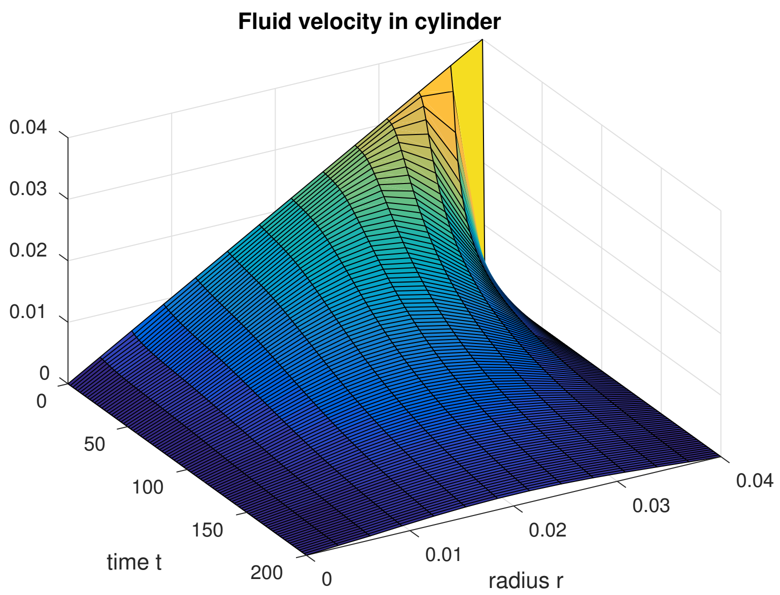

Figure 1: Solution for one dimension

2 dimension

TODO

Matlab codes