Problem 6

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September 15, 2024

1 Problem formulation

$$\begin{cases} \dot{c}_1 = D\Delta c_1 - 3c_1c_2 \\ \dot{c}_2 = D\Delta c_2 - 5c_1c_2 \\ \dot{c}_3 = 2c_1c_2 \end{cases} \tag{1}$$

where $\dot{c}$ is the time derivative $\frac{\partial c}{\partial t}$ and Δ is the Laplace operator $\Delta = \frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}$.

1.1 Initial conditions

$$\begin{aligned} c_1(x,y,0) &= \begin{cases} 1, \text{if } x \in A \\ 0, \text{otherwise} \end{cases} &, \quad (x,y) \in [0,L] \times [0,L] \\ c_2(x,y,0) &= \begin{cases} 1, \text{if } x \notin A \\ 0, \text{otherwise} \end{cases} &, \quad (x,y) \in [0,L] \times [0,L] \\ c_3(x,y,0) &= 0 &, \quad (x,y) \in [0,L] \times [0,L] \end{aligned} \tag{2}$$

where $A = [0, 0.5L] \times [0, 0.5L] \cup [0.5L, L] \times [0.5L, L]$.

1.2 Boundary conditions

$$\begin{aligned} \frac{\partial u}{\partial x}\Big|_{x=0} = \frac{\partial u}{\partial x}\Big|_{x=L} = 0, \quad y \in [0,L], \quad t \in [0,T] \\ \frac{\partial u}{\partial y}\Big|_{y=0} = \frac{\partial u}{\partial y}\Big|_{y=L} = 0, \quad x \in [0,L], \quad t \in [0,T] \end{aligned} \tag{3}$$