Fluid Mechanics: Worksheet 3

June 2019

Excercises

1. Download Explicit.m and run it! You should see a bump that diffuses following the diffusion equation.
2. Altering the previous code, solve the following reaction-diffusion equation

$$\partial_t f = \kappa \Delta f + f(1-f)$$

with the same initial conditions as before. With $\kappa = 0.1$, $\kappa = 0.01$ and $\kappa = 0.001$. What is the difference in behavior in each case?

3. Altering the code, solve the spatially inhomogeneous Lotka-Volterra model

$$\begin{cases} \partial_t u = \kappa_u \Delta u + u(1-v) \\ \partial_t v = \kappa_v \Delta v - v(1-u). \end{cases}$$

To plot both the populations of rabbits and foxes at the same time use the command:

subplot(1,2,1)

surf(X,Y,u)

subplot(1,2,2)

surf(X,Y,v)

The initial conditions and parameters should be the following

- Both u and v have the initial conditions as in the first excercise. Diffusivity coefficients $\kappa_u = \kappa_v = 0.001$.
- With

$$u(x,y) = \begin{cases} 1/2 & \text{if } (x-1/4)^2 + (y-1/4)^2 < 1/16 \end{cases}$$

$$v(x,y) = \begin{cases} 1/2 & \text{if } (x-3/4)^2 + (y-3/4)^2 < 1/16 \end{cases}$$

Diffusivity coefficients $\kappa_u = \kappa_v = 0.001$.
- Same initial conditions as the previous exercise. $\kappa_u = 0.01$ $\kappa_v = 0.001$
- Play around with parameters and initial conditions.