

ADI for Reaction- Diffusion Systems

Gray-Scott reaction-diffusion

Reaction-Diffusion system (see Project 3 from HPCSE I):

$$\frac{\partial u}{\partial t} = D_u \Delta u - uv^2 + F(1 - u),$$

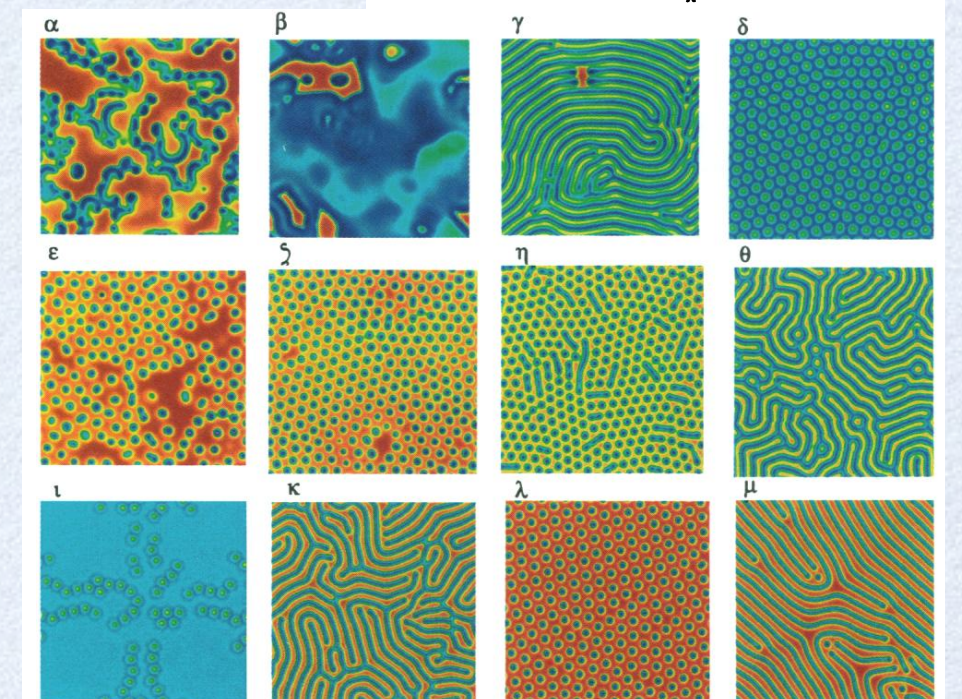
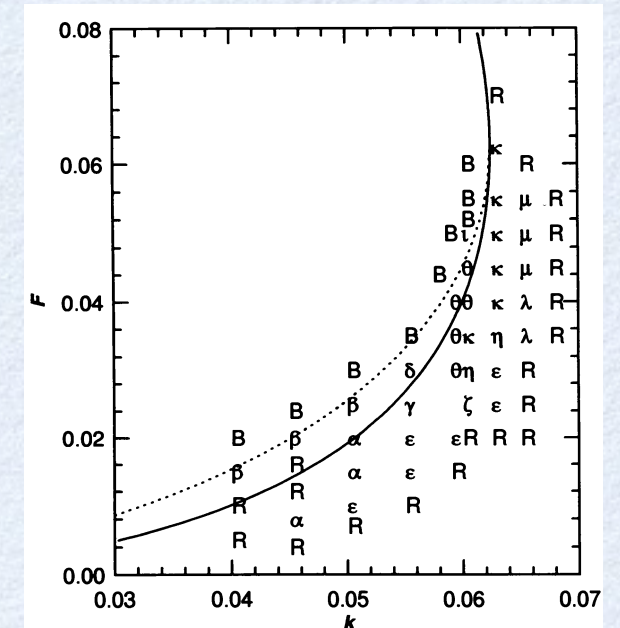
$$\frac{\partial v}{\partial t} = D_v \Delta v + uv^2 - (F + k)v.$$

u, v : chemical species

F, k : model parameters

Sample parameters:

$F=0.03, k=0.062, D_u=2e-5, D_v=1e-5$



Alternate direction implicit

Diffusion equation $\frac{\partial \rho}{\partial t} = D_\rho \Delta \rho$ with ADI

Step 1

$$\rho_{i,j}^{n+\frac{1}{2}} = \rho_{i,j}^n + \frac{D\delta t}{2} \left[\frac{\partial^2 \rho_{i,j}^{n+\frac{1}{2}}}{\partial x^2} + \frac{\partial^2 \rho_{i,j}^n}{\partial y^2} \right]$$

explicit

Step 2

$$\rho_{i,j}^{n+1} = \rho_{i,j}^{n+\frac{1}{2}} + \frac{D\delta t}{2} \left[\frac{\partial^2 \rho_{i,j}^{n+\frac{1}{2}}}{\partial x^2} + \frac{\partial^2 \rho_{i,j}^{n+1}}{\partial y^2} \right]$$

implicit

Alternate direction implicit

