Program trans.f simulates the transport equation

$$\frac{\partial f}{\partial t} + u\frac{\partial f}{\partial x} - \alpha\frac{\partial^2 f}{\partial x^2} = 0$$

and as a special case with $\alpha = 0$ also the convection equation.

The fortran code require 3 files:

- trans.f - source code of the program
- transin - include fiel with parameter declarations
- trans1.dat - parameter file to select methods and parameters to run the program

Plotting: 2 idl programs

- tanim.pro - program to generate small animation from the output data. Execute this program once (.r tanim). To recycle the animation enter *xanimate, 2* at the idl prompt after running tanim. To obtain a smooth animation you may need to lower nout (in trans1.dat) and use a larger number of frames per second in xanimate: xanimate, 4
- trans.pro - program to plot (also in postscript) output from trans.f . The thick solid lines are the initial and the final solution. The thin solid line is the exact final solution. The dashed lines represent the intermediate solution. If there are to many or to few intermediate solution change the parameter nout accordingly.

The program implements 5 different methods:

- Upwind
- Leapfrog
- Lax-Wendroff
- FDM Crank-Nicholson
- FEM Crank-Nicholson

For the Lax-Wendroff and Crank-Nicholson methods a parameter q can switch between 3pt centered difference and 4pt upwind difference approx. where q (or quein trans1.dat) can be any value between $q = 0$ (=> 3pt diff) and $q = 0.5$ (=>4pt upwind). The generalized finite element Crank-Nicholson method is obtained through any non-zeror value of δ (delta in trans1.dat).

Parameters in trans1.dat:

ntmax - max number of integration steps

tmax - final time

xmin, xmax - boundaries in x

u - convection velocity

c - parameter c in convection equation

dt - time step

cordt - switch whether tiestepping is determined through c or directly through dt (note one of these is determined through the other if u and dx are fixed)

delta - mass operator weight for FEM method

que - switch for 3pt centered or 4 pt upwind difference approx

nout - number of integration steps between outputs

f0 - normalization of f

init - chooses initial condition between truncated sine wave (1), sine wave (2), or rectangular pulse (3)

lambda - wavelength or pulse size

fb(i) - boundary value at xmin and xmax

maxex - number of modes in the exact solution.