Coursework Project I

Konstantinos Drakopoulos

November 24, 2015

Question 1

Investigate the stability and accuracy of the four schemes in terms of the Courant-Friedrichs-Lewy (CFL) numbers $\lambda = c\frac{dt}{dx}$ *and* $\mu = \nu\frac{dt}{dx^2}$*. In particular use numerical experimentation and/or von Neumann stability analysis to determine stability boundaries.*

Question 2

Use the exact solution as an initial condition for your simulations and compare the numerical results against the exact ones at a later time. Consider whether the integral 'constants' $A = \int_{-\infty}^{\infty} f dx$ *and* $E = \int_{-\infty}^{\infty} \frac{1}{2} f^2 dx$ *are conserved (or not) as appropriate.*

Question 3

Investigate the solutions when the viscosity is very small (in effect, zero) so that we reduce to the one-dimensional wave equation. Look the amplitude (growth/decay, stability) and dispersion (phase speed of wave components. One way to retain stability is to add an optimal small amount of artificial viscosity (e.g. the Lax-Wendroff method, Euler+CDiff2, using $\nu = 0.5c^2 dt$*).*

Question 4

Investigate the solutions when convection is negligible ($c = 0$)*. Look at the accuracy and stability limit in terms of* $\mu = \nu\frac{dt}{dx^2}$ *for the different schemes.*

Question 5

Finally, discuss your results in terms of which schemes are best suited to be used for simulations of turbulent flows.