

Physics 503: Scientific Computing

Homework #9

Topic: Solutions to PDEs

Due: Friday April 27 by midnight.

Assignment

The more advanced version of the wave equation code I posted on the website allows for a variable wavespeed which would allow one to investigate a “heterogeneous” medium for the wave. Take this code and alter it to allow for a wavespeed which also can depend on the amplitude of the wave (the deviation of the solution at each x point from $u=0$). This constitutes a “non-linear” wave. Try a oscillating source term somewhere in your domain (could be one of the BCs at $x=0$ say). You may use my code as a starting point.

1. Consider a step function for C (assume a domain for $x = [0,10]$). Run this in the linear regime ($c(x)$ does not depend on amplitude). Generate some waterfall plots to record the system over time.
 - a. Step function at $x=5$: $c(x) = \begin{cases} 1 & x < 5 \\ 2 & x > 5 \end{cases}$
2. Repeat for a non-linear case such that the wavespeed linearly increases with amplitude: $c(u) = au + c_0$. The slope (a) will be a measure of how nonlinear the system is. Also generate a waterfall plot for this case.