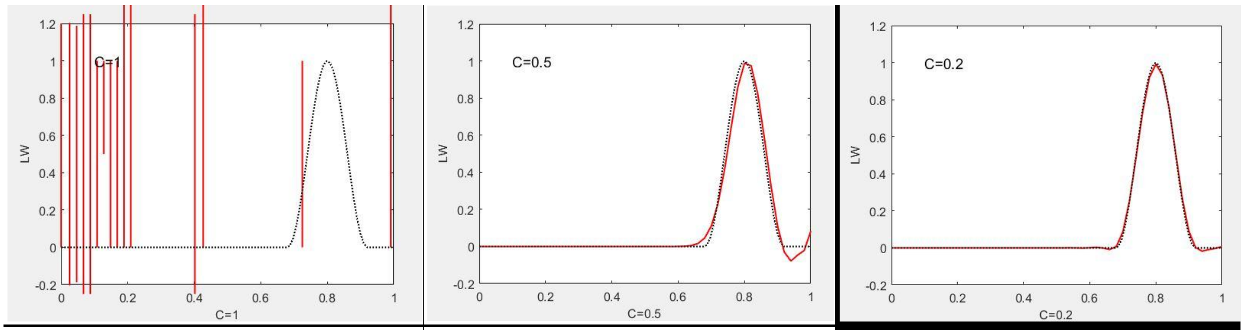
FINITE ELEMENTS IN FLUIDS

ASSIGNMENT5- PROPAGATION OF A COSINE PROFILE

-By Anurag Bhattacharjee

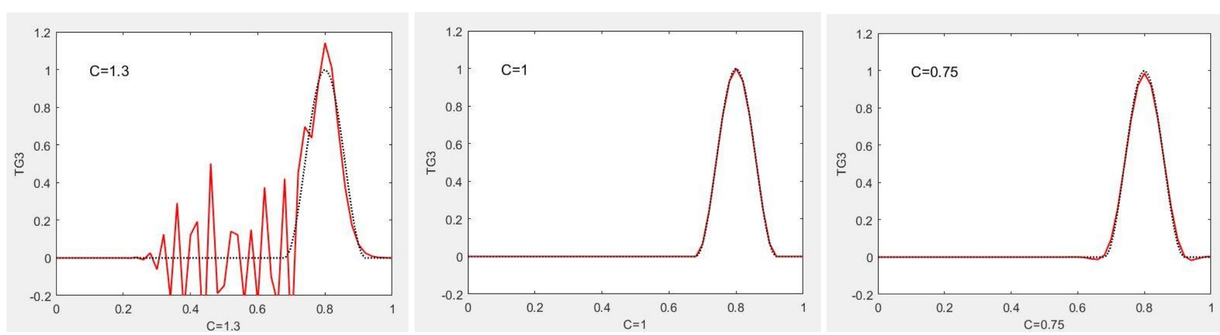
Second Order Lax Wendroff Method



C=1 C=0.5 C=0.2

The second order Lax Wendroff method is an explicit method with stability criteria of $C^2<1/3$. The plots obtained from the code provided appears to be in accordance with the theory. Highly unstable for $C^2>1/3$. Relative Phase error rises slightly for C=0.5 and is stable for lower values of Courant number which can be seen from the above plots.

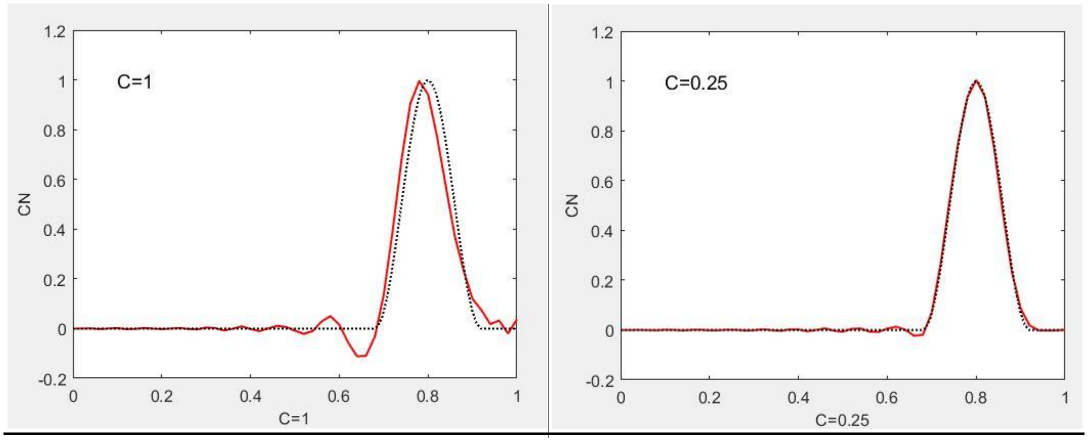
Third Order Explicit Taylor Galerkin Method



C=1.3 C=1 C=0.75

The third order explicit Taylor Galerkin formulation is has stability criteria of $C^2<=1$. As can be verified from the above plots it is unstable for values greater than 1 and gives exact solution for $C^2=1$. However, in accordance with the theory there is a slight relative phase error for C=0.75 which can be seen at the tip of the plot for C=0.75.

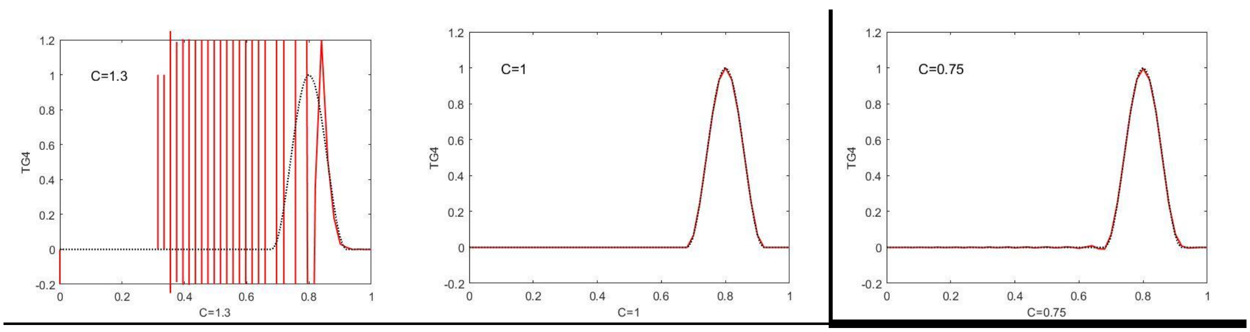
Second Order Crank Nicolson Method



C=1 C=0.25

Even though Crank Nicolson is second order implicit method we still find oscillations for C=1. This supports the theory which states that Crank-Nicolson + Galerkin formulation shows decreasing accuracy for higher time steps. For lower time steps C=0.25 the result is relatively much more stable.

Fourth Order Implicit Taylor Galerkin Method



C=1.3 C=1 C=0.75

The fourth order Taylor Galerkin method behaves as expected. Gives stable solutions for C^2<=1. From the plot we also see that for C=1, we get a perfect match which is due to its fourth order of accuracy. However, we find that slight oscillations appear for lower values of C which can be probably attributed to it's increase in phase error for lower time steps or low values of C.