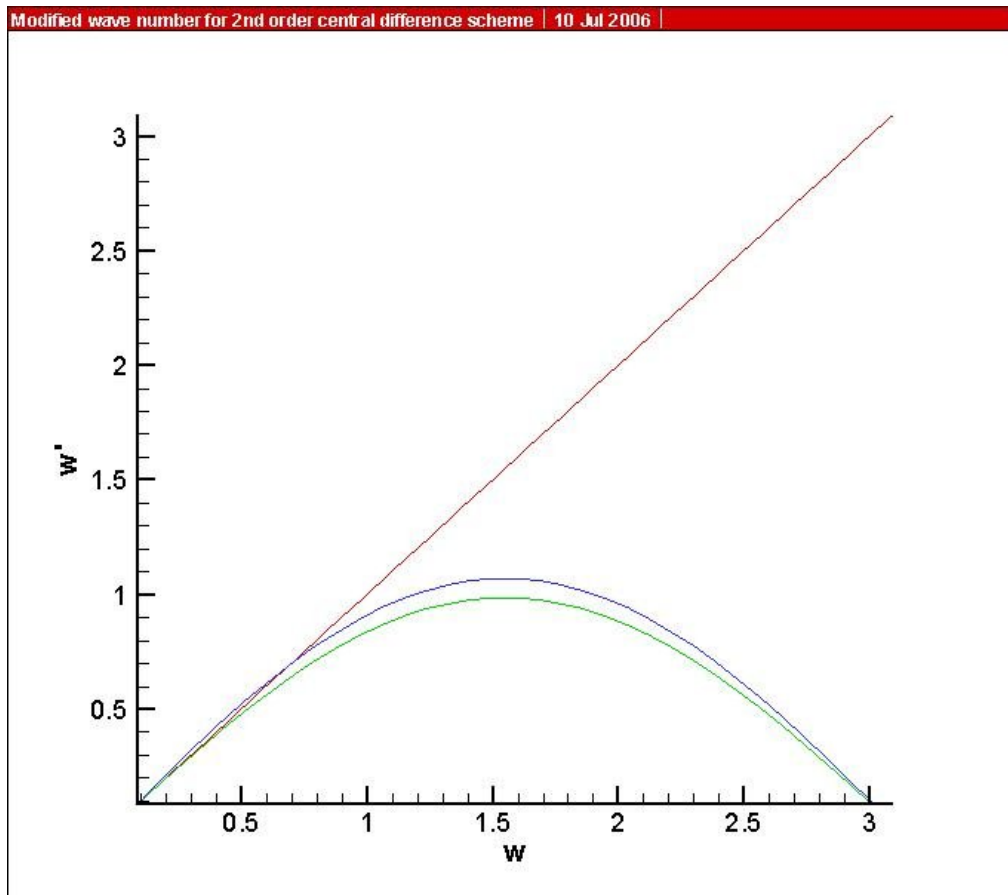


## The modified wave number graph for 2<sup>nd</sup> order finite difference scheme

- The domain size is  $[-\pi, \pi]$
- Number of grid point is 70 grid points and so,  $d\zeta = 2\pi/70$
- Grid point is start from 1 to  $n+1$
- Transformation function is  $x = \pi \left( \frac{\tanh(\gamma\xi)}{\tanh(\gamma\pi)} \right)$  where  $\gamma = 2$
- The function that used to calculate the modified wave number is  $f = \sin(kx)$
- The modified wave number is calculated by  $k' = \frac{f'}{\sqrt{1-f^2}}$
- $f' = \frac{f_{i+1} - f_{i-1}}{2d\xi} \times \frac{d\xi}{dx}$  where  $\frac{d\xi}{dx} = \frac{\tanh(\gamma\pi)}{\pi(\gamma - \gamma \tanh^2(\gamma\xi))}$
- The point of approximation (xpos) is -2.902
- The position of approximated point is said to be position j
- So, for the nonuniform grid part,
  - o When
$$\text{ufscd}(k) = ((\sin(k*(xpos+d\zeta)) - \sin(k*(xpos-d\zeta)))/(2*d\zeta))*(1/du(j)) \text{----(**)}$$

where, ufscd(k) is the 2<sup>nd</sup> order central difference approximation with nonuniform grid. And  $du(j) = dx/d\zeta$  at position  $x(j)$

The following graph is obtained.



Where Red – the exact solution, Green – uniform grid approximation and Blue – nonuniform grid approximation