

# Daily Research Report

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## 1 Current Research Direction

The current research direction is to investigate the Taylor Series central spatial differencing for the radial derivatives needed in SWIRL. The investigation will be done by looking at the wavenumber performance.

## 2 Research Performed

Defining the numerical wavenumber  $(k\Delta x)^*$  as

$$\left(\frac{\partial f}{\partial x}\right)_{numerical} = ik \left(\frac{(k\Delta x)^*}{k\Delta x}\right) \exp^{ikx_0} \quad (1)$$

If we plot the parameter  $[k\Delta x]^*$  as a function of  $k\Delta x$  from  $0 \leq k\Delta x \leq \pi$  we could compare second order fourth order and the RDRP schemes used in SWIRL. The second order scheme was analyzed, but the fourth order and RDRP.

The next two plots should be the numerical wavespeed and its error

$$\tilde{c} = \left(\frac{(k\Delta x)^*}{k\Delta x}\right) \quad (2)$$

$$\epsilon = \left(\frac{(k\Delta x)^*}{k\Delta x} - 1\right) \quad (3)$$

## 3 Issues and Concerns

None at the moment. The question is how many grid points per wavelength is needed to attain 99.9%?

## 4 Planned Research

Complete the analysis for these schemes and provide plots that show their performance.