Methods, Results, and Discussion: Code Validation for SWIRL

Jeffrey Severino

University of Toledo

Toledo, OH 43606

email: jseveri@rockets.utoledo.edu

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0.1 Methods

A comparison was conducted for a hollow cylinder undergoing uniform flow with acoustic liners along the outer duct perimeter. The azimuthal mode number, reduced frequency, mach number and duct liner admittance is reported below,

$$m = 2$$
$$k = \frac{\omega r_T}{A_T} = -1$$
$$M_x = 0.5$$
$$\eta_T = 0.72 + 0.42i$$

1 Results

Notes about results

- Figure **??** shows the effect of varying grid points. The wavenumbers seem to fall more into their categories as opposed to being sporadic.

- Figures **??**-**??** show the cut on modes

- Figures **??**-**??** show the cut off modes. Notice how they decay down to zero at the walls

- Figure **??** shows point to point waves

- The axial wavenumbers and propagating radial pressure modes are indexed according to the number of zero crossings that occur for the real component of the mode. The superscript indicates the sign of the axial wavenumber while the subscript indicates the number of times that the corresponding radial pressure mode crosses zero

1.1 Propagating (Cut-on) pressure modes

1.2 Discussion

Notes to ponder on...

- The cut-on line is not parallel to the imaginary axis.

- Modes are only shown for two radial modes with the same azimuthal mode in Kousen's work

- Maldanado's plot of axial wave numbers has much less points. This could have been by choice or they were eliminated using the Tam dissipation filter

2 Issues and Concerns

Looking at the magnitude shows the phase shift a bit more clearly.

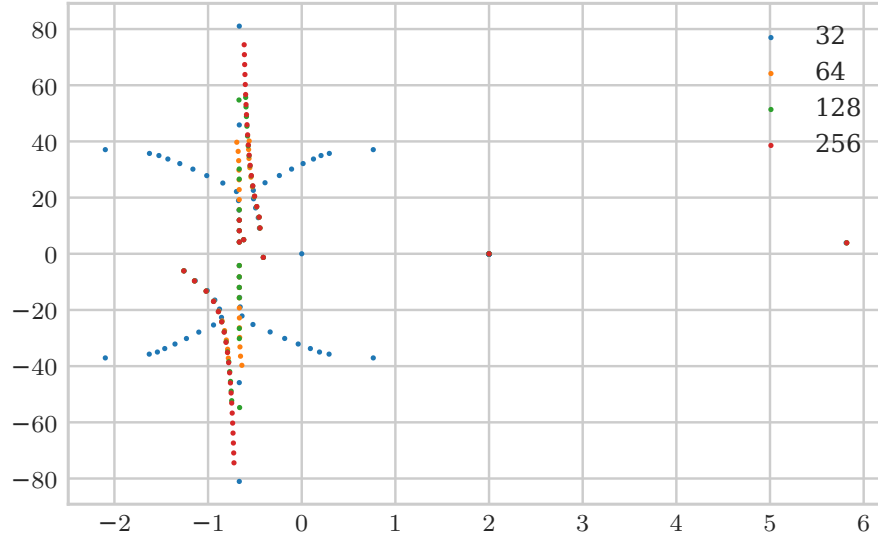The number of zero crossings don't seem to correspond to the subscript of γ...

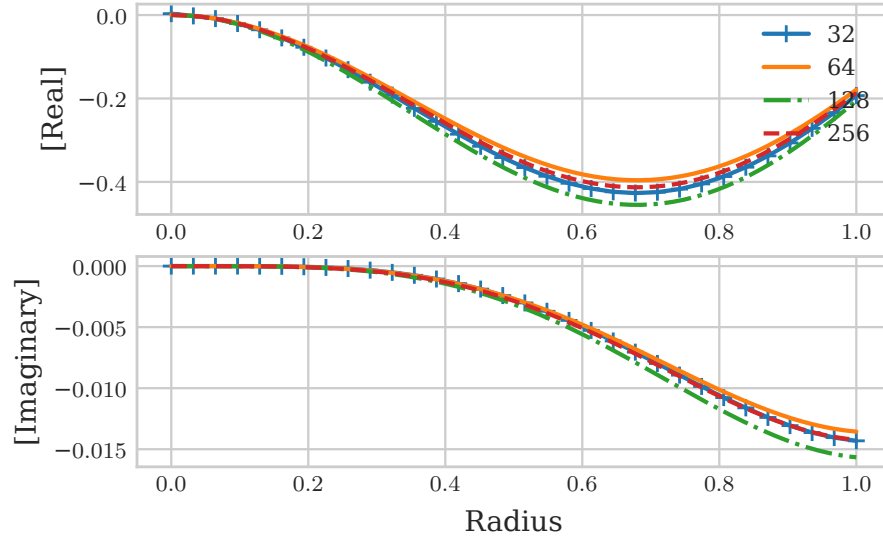Figure 1: Discrete Acoustic Disturbances: Cylinder, Uniform Mean Flow with Liner.

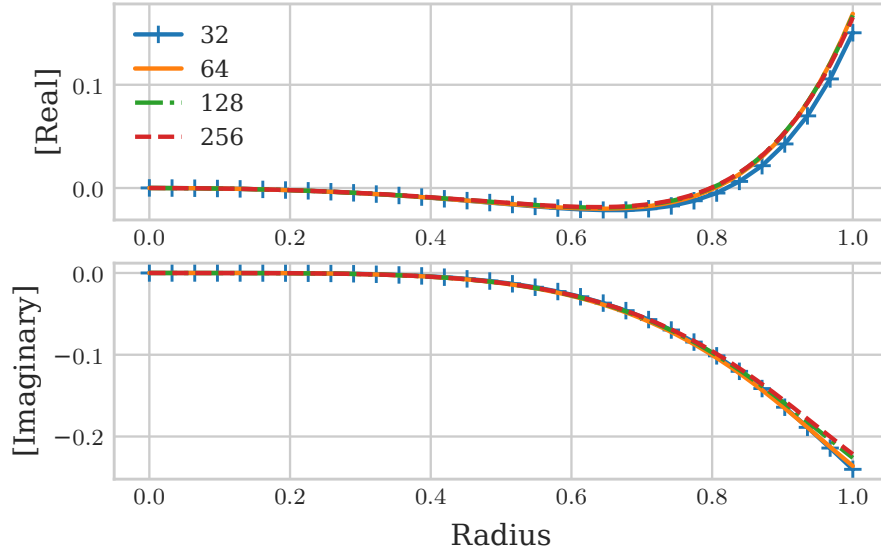Figure 2: Propagating Mode $\gamma_0^+ = 0.620 - 5.014i$

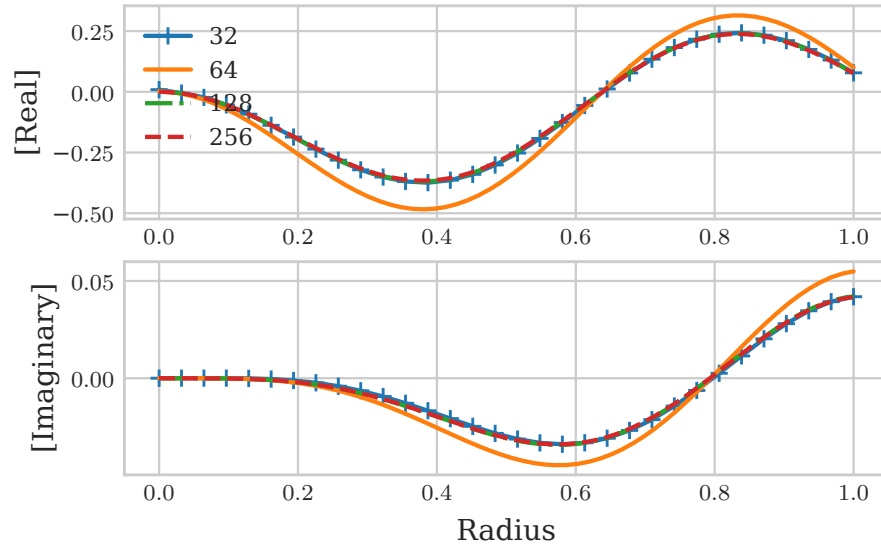Figure 3: Propagating Mode $\gamma_1^+ = -5.820 - 3.897i$

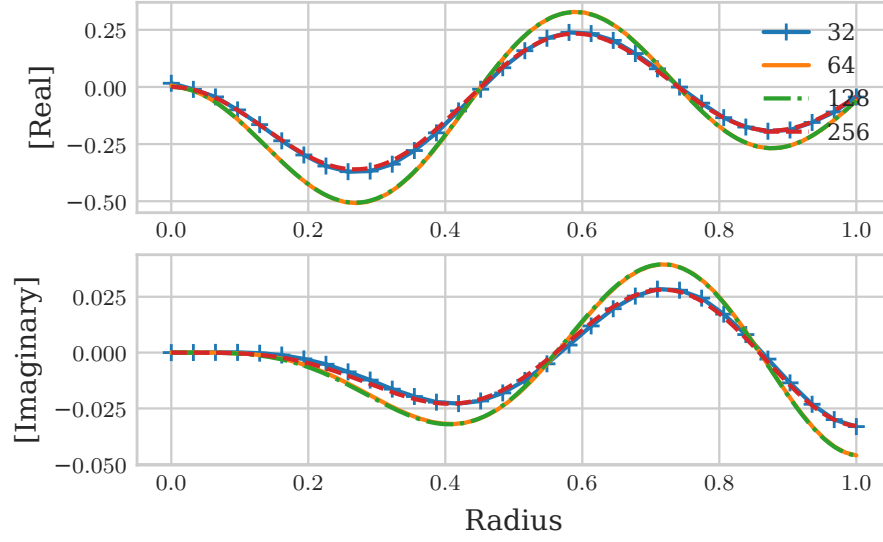Figure 4: Propagating Mode $\gamma_2^+ = 0.445 - 9.187i$

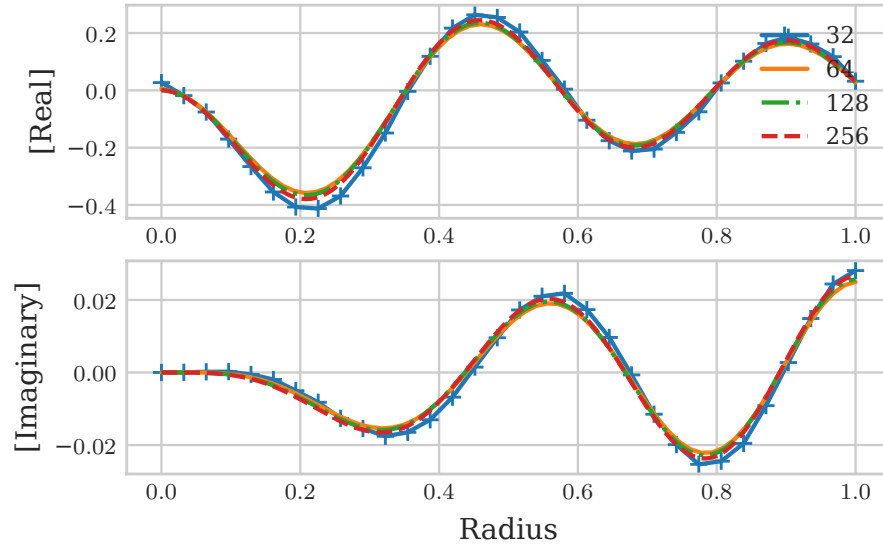Figure 5: Propagating Mode $\gamma_3^+ = 0.453 - 13.062i$

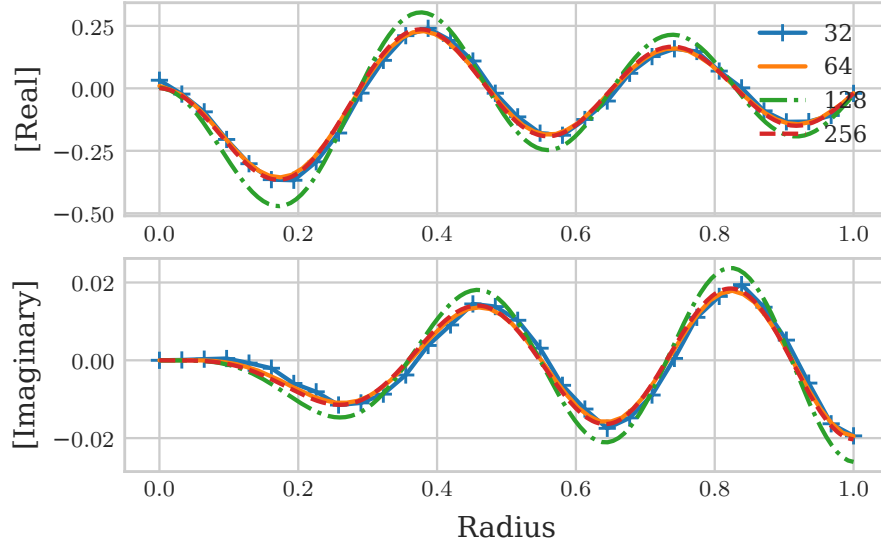Figure 6: Propagating Mode $\gamma_4^+ = 0.480 - 16.822i$

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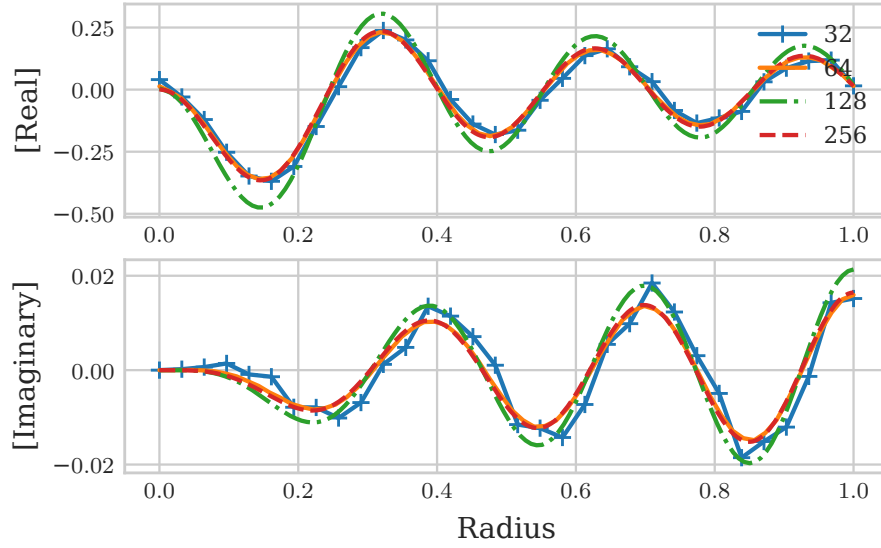Figure 7: Propagating Mode $\gamma_5^+ = 0.503 - 20.531$

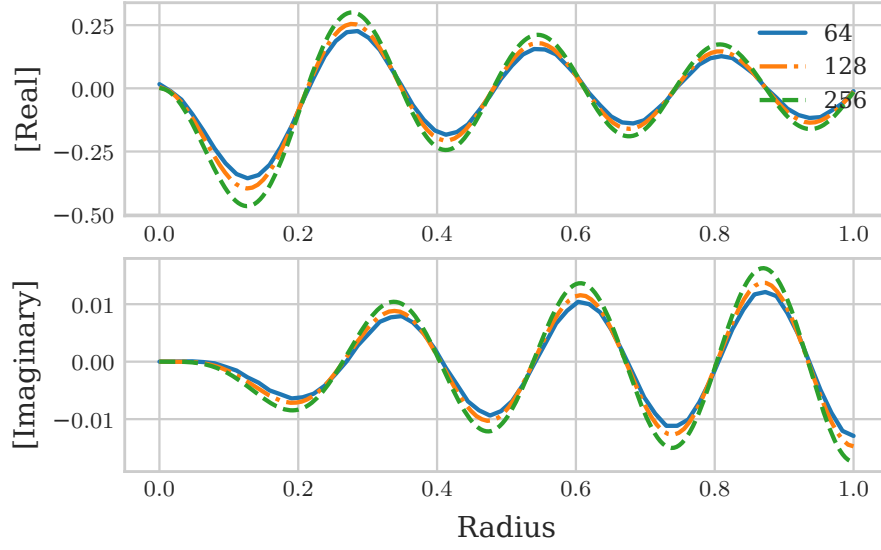Figure 8: Propagating Mode $\gamma_6^+ = 0.522 - 24.213i$
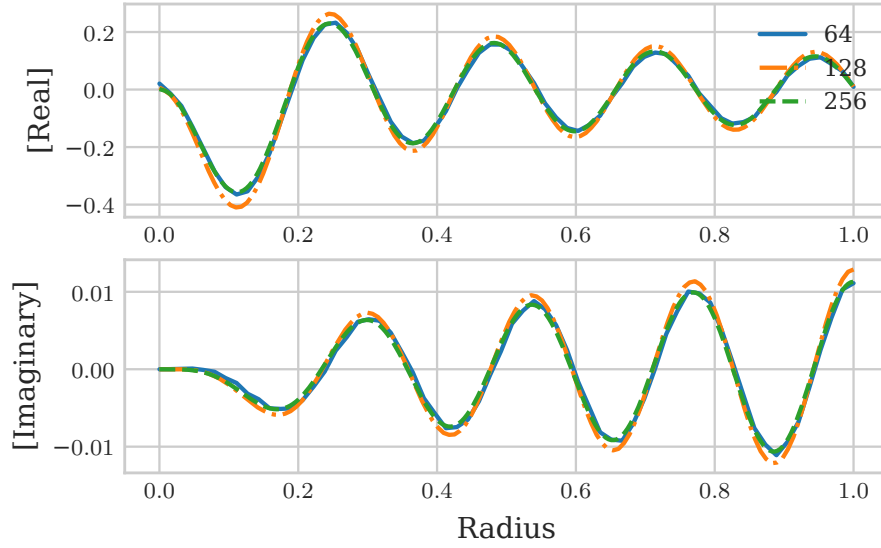
Figure 9: Propagating Mode $\gamma_7^+ = 0.538 - 27.880i$

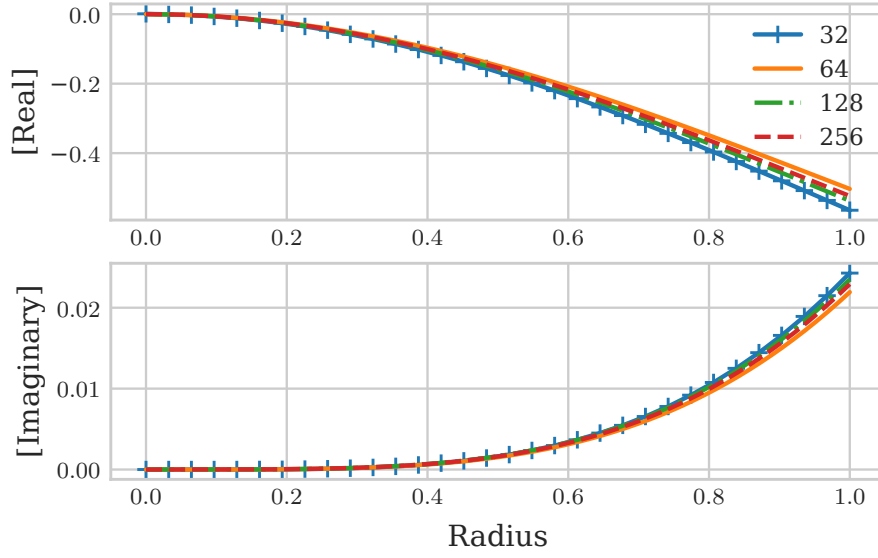Figure 10: Propagating Mode $\gamma_8^+ = 0.550 - 31.537$

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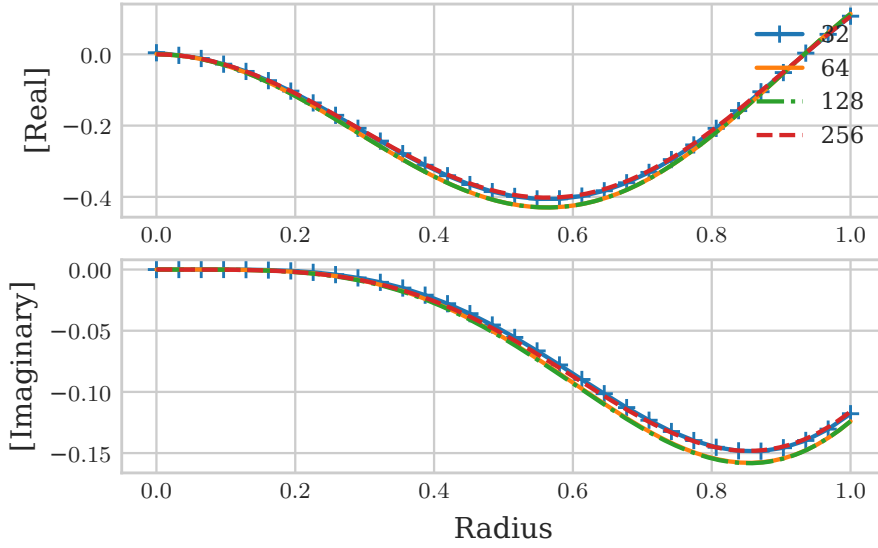Figure 11: Propagating Mode $\gamma_0^+ = 0.620 - 5.014i$

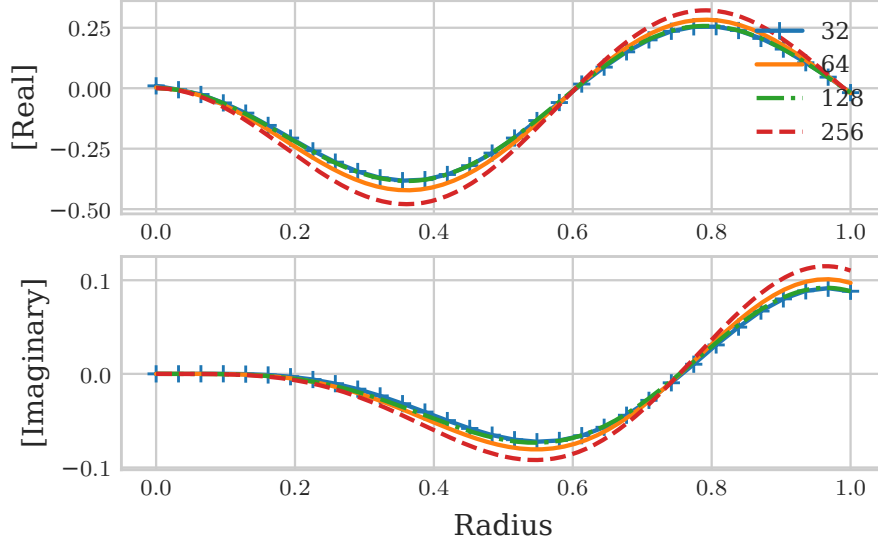Figure 12: Propagating Mode $\gamma_1^+ = -5.820 - 3.897i$

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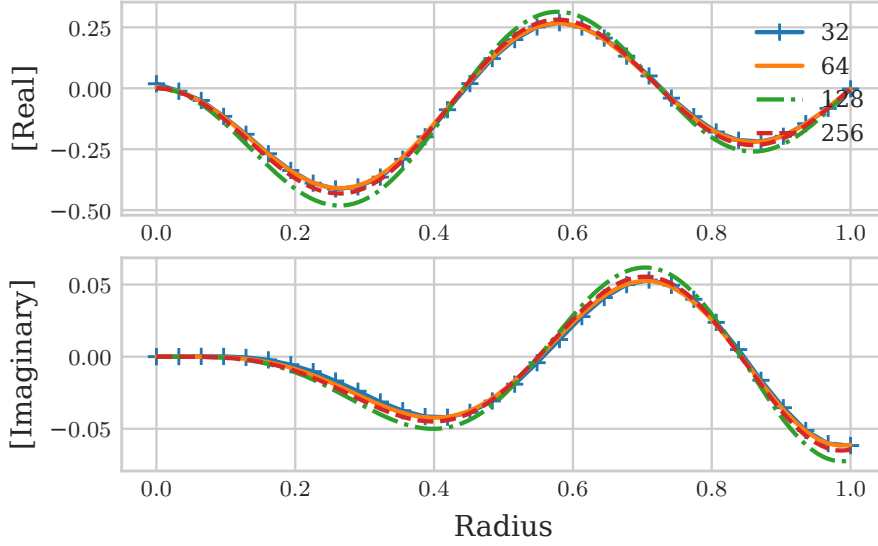Figure 13: Propagating Mode $\gamma_2^+ = 0.445 - 9.187i$

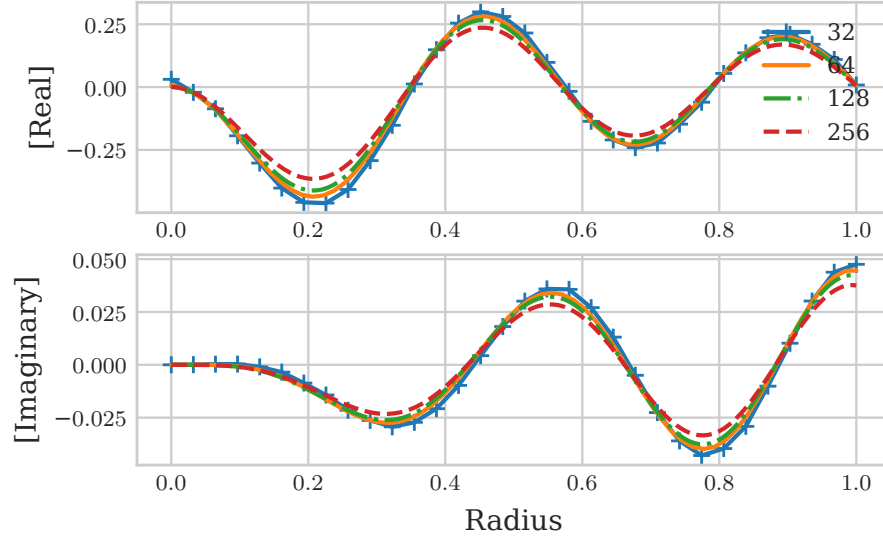Figure 14: Propagating Mode $\gamma_3^+ = 0.453 - 13.062i$

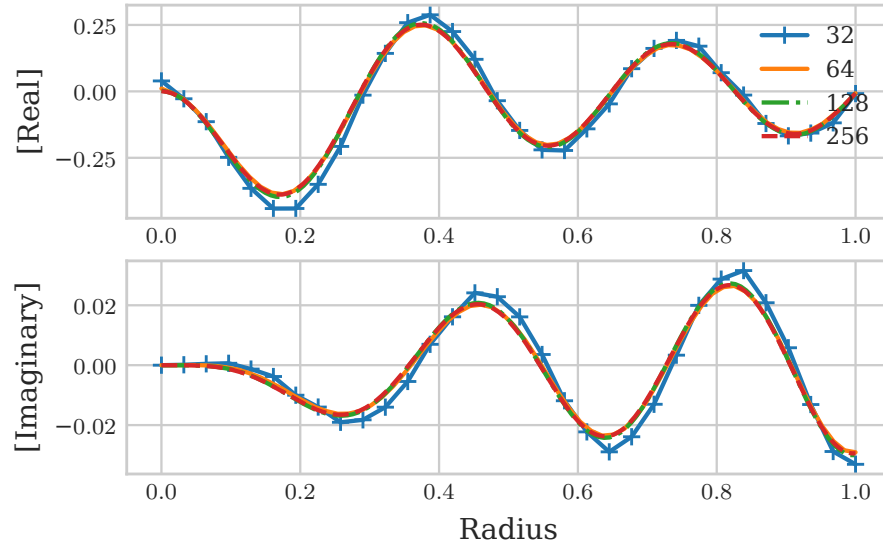Figure 15: Propagating Mode $\gamma_4^+ = 0.480 - 16.822i$

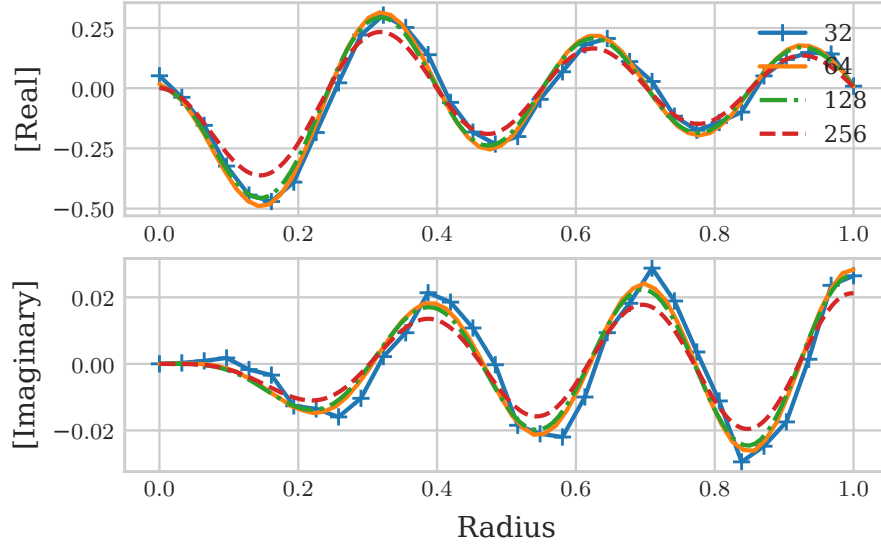

Figure 16: Propagating Mode $\gamma_5^+ = 0.503 - 20.531$

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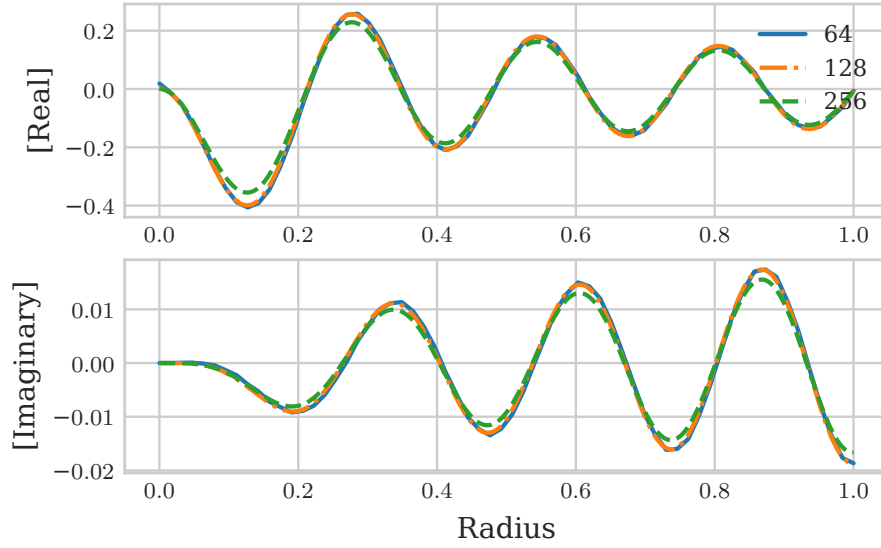Figure 17: Propagating Mode $\gamma_6^+ = 0.522 - 24.213i$

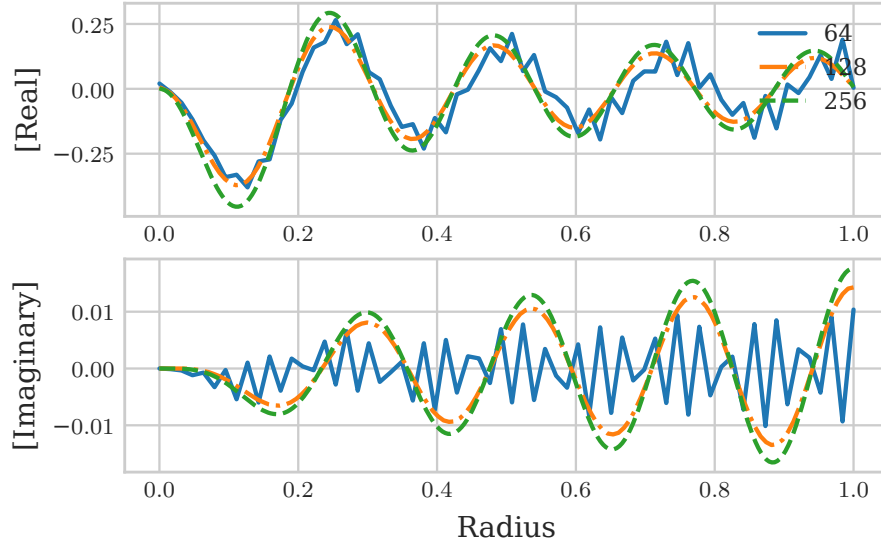Figure 18: Propagating Mode $\gamma_7^+ = 0.538 - 27.880i$

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Figure 19: Propagating Mode $\gamma_8^+ = 0.550 - 31.537$

3 Planned Research

- I would like to document the methods for this section to describe the validation. Also there is no comparison to an analytical mode at the moment.

- To complete the validation for Table4.3, a fourth order scheme needs to be shown.

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