

Weekly Research Report

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γ_n^\pm	Kousen Ref. [15]	Kousen report	srcF2008	index	current	index
γ_0^+	0.620 - 5.014i	0.6195 - 5.0139i	0.61954 - 5.01386i	60	0.620755853112 - 5.00592416941i	34
γ_1^+	-5.820 - 3.897i	-5.8195 - 3.8968i	-5.81953 - 3.89677i	58	-0.581267772517 - 3.90050864568i	33
γ_2^+	0.445 - 9.187i	0.4453 - 9.1868i	0.44533 - 9.18684i	59	0.451569491142 - 9.12191317214i	31
γ_3^+	0.453 - 13.062i	0.4539 - 13.062i	0.45389 - 13.0615i	57	0.464247902898 - 12.8487472519i	29
γ_4^+	0.480 - 16.822i	0.4795 - 16.822i	0.47952 - 16.8216i	55	0.492340380223 - 16.3292825150i	27
γ_5^+	0.503 - 20.531i	0.5029 - 20.531i	0.50287 - 20.5307i	51	0.514522630594 - 19.5817182568i	25
γ_6^+	0.522 - 24.213i	0.5220 - 24.213i	0.52202 - 24.2129i	50	0.516658239854 - 22.5715880605i	23
γ_7^+	0.538 - 27.880i	0.5376 - 27.880i	0.53754 - 27.8800i	48	-	-
γ_8^+	0.550 - 31.537i	0.5502 - 31.537i	0.55024 - 31.5368i	47	-	-
γ_9^+	0.589 - 49.75i	0.5891 - 49.754i	0.58745 - 49.7669i	33	-	-
γ_0^-	0.410 + 1.290i	0.4101 + 1.2904i	0.41009 + 1.29037i	64	0.409973310292 + 1.29020083859i	64
γ_1^-	1.259 + 6.085i	1.2595 + 6.0852i	1.25949 + 6.08517i	63	1.25530612217 + 6.07214375548i	62
γ_2^-	1.146 + 9.668i	1.1457 + 9.6679i	1.14567 + 9.66787i	62	1.13696444935 + 9.59622801724i	60
γ_3^-	1.022 + 13.315i	1.0218 + 13.315i	1.02183 + 13.3150i	61	1.00950576515 + 13.0957277529i	58
γ_4^-	0.943 + 16.977i	0.9425 + 16.977i	0.94250 + 16.9767i	56	0.928059983039 + 16.4791343118i	56
γ_5^-	0.891 + 20.635i	0.8908 + 20.635i	0.89075 + 20.6353i	54	0.856678172769 + 22.6544943903i	52
γ_6^-	0.855 + 24.288i	0.8549 + 24.288i	0.85490 + 24.2883i	53	0.941762848775 + 25.3460188358i	50
γ_7^-	0.829 + 27.937i	0.8288 + 27.937i	0.82877 + 27.9369i	52	-	-
γ_8^-	0.809 + 31.581i	0.8089 + 31.581i	0.80891 + 31.5812i	49	-	-
γ_9^-	0.755 + 49.77i	0.7547 + 49.772i	0.75658 + 49.7851i	39	-	-

Table 1: Table 4.3 data

1 Research Performed In the Past 24 hours

1.1 Current Validation Work

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,

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

The results shown in 3 are in moderately good agreement. The results were obtained by visually comparing the output in `gam.acc` for 32 grid points. Note that the indices for the SWIRL deliverable are different that the ones obtained for the most recent version of the code. While the convective axial wavenumbers show agreement to machine precision, this is not particularly insightful given that there are an infinite number of possible solutions that could satisfy the eigenvalue problem. The results that are of concern are propagating modes that are not convecting with the mean flow. The scatter plot of the axial wavenumbers show some sporadic behaviour around the imaginary axis. The results from the MMS along with this plot indicate that more grid points are going to be needed if a finite difference technique is to be used. It should be noted that a spectral differencing method were using for Kousen's report and for srcF2008. Using a higher order scheme would also improve accuracy.

Using more grid points improved the comparison between wavenumbers, however γ_9^\pm were difficult to identify, however with 32 grid points, γ_{7-9}^\pm were also difficult to identify. In general, there is okay agreement, but this shows that more grid is needed or a higher order scheme. Note the dissimilarity between indices, but the wavenumbers are relatively near each other, being only 2-5 indices away from each other.

γ_n^\pm	srcF2008	index	32 points	index	64 points	index
γ_0^+	0.61954 - 5.01386i	60	0.620755853112 - 5.00592416941i	34	0.619830466387E + 00 - 0.501195898338E + 01i	68
γ_1^+	-5.81953 - 3.89677i	58	-0.581267772517 - 3.90050864568i	33	-0.581874144252E + 01 - 0.389719406459E + 01i	67
γ_2^+	0.44533 - 9.18684i	59	0.451569491142 - 9.12191317214i	31	0.446784510254E + 00 - 0.917151486382E + 01i	65
γ_3^+	0.45389 - 13.0615i	57	0.464247902898 - 12.8487472519i	29	0.456385619609E + 00 - 0.130115227368E + 02i	63
γ_4^+	0.47952 - 16.8216i	55	0.492340380223 - 16.3292825150i	27	0.482906458331E + 00 - 0.167063669858E + 02i	61
γ_5^+	0.50287 - 20.5307i	51	0.514522630594 - 19.5817182568i	25	0.506963241913E + 00 - 0.203096267281E + 02i	59
γ_6^+	0.52202 - 24.2129i	50	0.516658239854 - 22.5715880605i	23	0.526558860613E + 00 - 0.238358532167E + 02i	55
γ_7^+	0.53754 - 27.8800i	48	-	-	0.542123590089E + 00 - 0.272859574060E + 02i	53
γ_8^+	0.55024 - 31.5368i	47	-	-	0.554191417366E + 00 - 0.306549838386E + 02i	51
γ_9^+	0.58745 - 49.7669i	33	-	-		
γ_0^-	0.41009 + 1.29037i	64	0.409973310292 + 1.29020083859i	64	0.410069261267E + 000.129033632980E + 01i	128
γ_1^-	1.25949 + 6.08517i	63	1.25530612217 + 6.07214375548i	62	0.125845417744E + 010.608210427128E + 01i	126
γ_2^-	1.14567 + 9.66787i	62	1.13696444935 + 9.59622801724i	60	0.114350845928E + 010.965104848780E + 01i	124
γ_3^-	1.02183 + 13.3150i	61	1.00950576515 + 13.0957277529i	58	0.101870775473E + 010.132634680645E + 02i	122
γ_4^-	0.94250 + 16.9767i	56	0.928059983039 + 16.4791343118i	56	0.938535330387E + 000.168600097406E + 02i	120
γ_5^-	0.89075 + 20.6353i	54	0.856678172769 + 22.6544943903i	52	0.886130853983E + 000.204129469402E + 02i	118
γ_6^-	0.85490 + 24.2883i	53	0.941762848775 + 25.3460188358i	50	0.849927767573E + 000.239101576350E + 02i	116
γ_7^-	0.82877 + 27.9369i	52	-	-	0.823875448687E + 000.273421537697E + 02i	114
γ_8^-	0.80891 + 31.5812i	49	-	-	0.804827463709E + 000.306993188999E + 02i	112
γ_9^-	0.75658 + 49.7851i	39	-	-		

Table 2: Table 4.3 data with higher resolution

2 Issues and Concerns

I need to move faster. Using vsplit between the output data and the report saves a bit of time as well as using the visual mode to copy and paste the numbers between files.

3 Planned Research

Documenting the wavenumbers took a bit longer than expected in tex format. I have ran 32 grid points and doubled the each time until 1024 for both fourth order and second order.