Weekly Research Report

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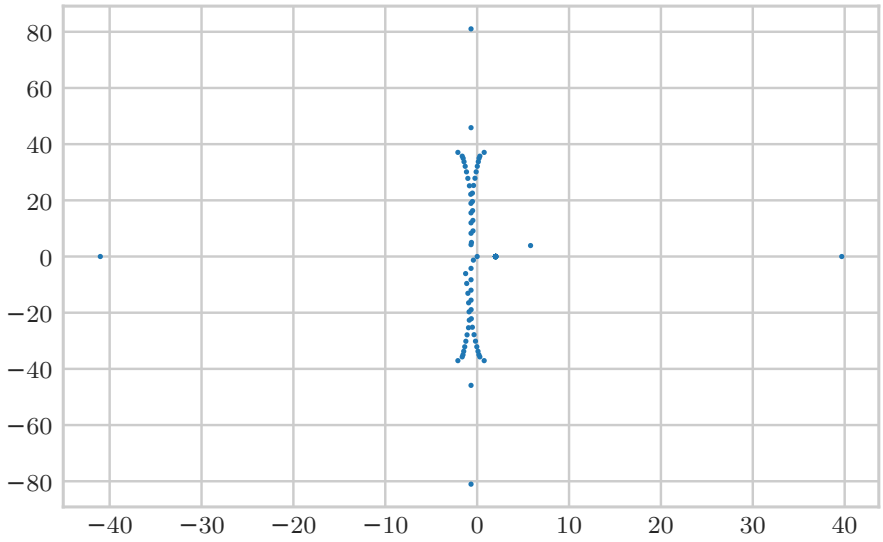
1 Research Performed In the Past 24 hours

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 1 are in moderately good agreement. The results were obtained by visually comparing the output in `gam.acc` for 32 grid points. Note that the indicies 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.

$\gamma_n^{\pm}$	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 - 5.005924169411i	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

2 Issues and Concerns

Is visual inspection the only way to compare wavenumbers? If I add more grid/use higher order scheme, will the comparison be easier to do? What if I used a grid that is known to reach convergence, will the axial wavenumbers begin to converge to an answer?

3 Planned Research

Increase number of grid points, and/or use a fourth order scheme to investigate this further