

Daily Research Report

Jeffrey Severino
University of Toledo
Toledo, OH 43606
email: jseveri@rockets.utoledo.edu

May 15, 2022

1 Current Research Direction

The goal is to find the analytical solution for a uniform flow case without liner. It isn't clear how the analytical solution changes with liner or if it changes at all. I suspect the boundary conditions have to be implemented because my current results do not match Table 4.3. There is a case that has shear flow in a cylinder but then the question becomes, what is the analytical case for sheared flow? If I could find a test case for uniform

2 Research Performed

The literature on duct modes in turbomachinery was reviewed to find test cases that can be used outside of Kousen's references but there is not any "readily" available. The best reference I could find was Maldonado's Figure 10 $m = 2$, " $Mach = 0.3$ ", " $He = 10$ ". The quotes are to indicate that a different variable was used. Since the case says it is uniform flow, the Mach number must be axial. A non dimensional frequency is often indicated as the Helmholtz number. There is no definition offered, but Rienstra often uses this and defines it just like we defined k . Maldonado also shows the effect of liner on the same case. After scanning literature, I think the best step is to replicate these results.

The analytical cut-on mode was calculated for this case and it was validated, but this doesn't provide the axial wavenumbers for this case. Perhaps I need to grab the values from this Figure!

3 Issues and concerns

It is unfortunate how cryptic it is to replicate these results easily. The steps are not clearly outlined from step to step and the conflicts between variable naming conventions can make it easy to make a mistake. Kerrebrocks and Rienstra's reference is a good starting point to replicate as they both cited Pridmore-Brown (1958) who cited Moore (1930s). It seems that's how far back this theory goes, but test cases are rarely provided. Maldonado's work helps in this endeavor a lot.

4 Planned Research

After reviewing the literature, Maldonado's Figure 10 in Sound Propagation in Lined Annular Ducts with MeanSwirling Flow has the best case to replicate because it has uniform flow in a cylindrical duct that is NOT lined