Validation using the Analytical Solution for Duct Mode Propagation in Uniform Flow

Swirl Validation

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This document shows the analytical duct mode solution as well as a numerical comparison.

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Toledo, OH
December 11, 2022

0.1 Introduction - Turbomachinery Noise

Turbomachinery noise generation occurs from pressure fluctuations from the series of fans within it's annular duct. While the jet that is produced from this stream of air freely radiates to the observer, the pressure fluctuations produced from the rotor may or may not propagate out of the inlet and exhaust and radiate to the observer. The production of this propagation can be characterized by standing waves referred to as modes, in particular, duct modes because the mode itself is dependent on the geometry of the column of air within the annular duct, as well as the speed of the flow moving through it

This document will provide the fundamental equations that describe sound propagation in ducted flow.

- Introduce the governing equations for compressible inviscid flow and the assumptions used to obtain them
- Demonstrate the linearization process and show the general equations that describe duct modes.
- The analytic solution for cylindrical and annular ducts with and without liner will be presented and used for validation against numerical approximations.

0.2 Results and Discussion