Rienstra, Sjoerd W.; **Eversman, Walter**

A numerical comparison between the multiple-scale and finite-element solution for sound propagation in lined flow ducts. (English) Zbl 0982.76077

J. Fluid Mech. 437, 367-384 (2001).

Summary: An explicit analytical multiple-scale solution for modal sound transmission through slowly varying ducts with mean flow and acoustic lining is tested against a numerical finite element solution, solving the same potential flow equations. The test geometry is representative of a high-bypass turbofan aircraft engine, with typical Mach number of 0.5-0.7, circumferential mode numbers m of 10-40, dimensionless wave-numbers of 10-50, and both hard and acoustically treated inlet walls of impedance $Z = 2 - i$. Of special interest is the presence of the spinner, which incorporates a geometrical complexity which could previously only be handled by fully numerical solutions. The results for predicted power attenuation loss show in general a very good agreement. The result for iso-pressure contour plots compare quite well in the cases where scattering into many higher radial modes can easily occur (high frequency, low angular mode), and again a very good agreement is found in other cases.

MSC:

76Q05 Hydro- and aero-acoustics
76M10 Finite element methods applied to problems in fluid mechanics

Keywords:

explicit analytical multiple-scale solution; modal sound transmission; slowly varying duct; acoustic lining; finite element solution; high-bypass turbofan aircraft engine; spinner; power attenuation; iso-pressure contour

Full Text: DOI