FLOW-INDUCED NOISE IN DUCT SYSTEMS

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Despite the increasing computational resources that are available nowadays, the decibel accuracy of an acoustic prediction is still challenging and expensive. For academic cases, high-level calculations can be performed but at high cost. Such computations are hardly possible in industrial context creating the necessary trade-off between the accuracy and the effectiveness. The purpose of this thesis is to investigate and improve the prediction of flow-induced noise in industrial duct flows with discontinuities, through different approaches.

A low-Mach flow through a symmetric slit diaphragm, placed in a square section duct and representing a generic valve, is numerically investigated. The implementation of Curle's analogy involves a 2-steps procedure: (i) the pressure and velocity fields are computed using a Large Eddy Simulation, (ii) the dipoles are extracted from the prior computation and propagated with a Boundary Element Method solver. The acoustic power radiated outside of the duct is compared with experimental data provided by literature [1].

Besides the work conducted on the square section duct, a second case is considered where the duct cross-section is circular. A slit diaphragm and a wall jet are investigated. An experimental study is conducted for validation purposes, in collaboration with the *Laboratoire d'Etudes Aerodynamiques* in Poitiers (France). This study is globally involved in the European network project AETHER and represents a collaborative work between the *von Karman Institute*, *LMS International* (Leuven, Belgium), *TNO Science & Industry* (Delft, the Netherlands) and the *Laboratoire d'Etudes Aerodynamiques*.

Figure 1 presents the geometry of the square cross-section duct with a slit diaphragm. The commercial software Fluent v6.3 was used for the Large Eddy Simulation. The fluctuating pressures at the walls are exported and the equivalent sources are determined. The commercial software Virtual.Lab v8 was used to propagate those sources and the Sound Power Level transmitted outside of the duct. Figure 2 represents the sound power levels computed (green squares) and its comparison with the results of Ref. [1] (grey line).

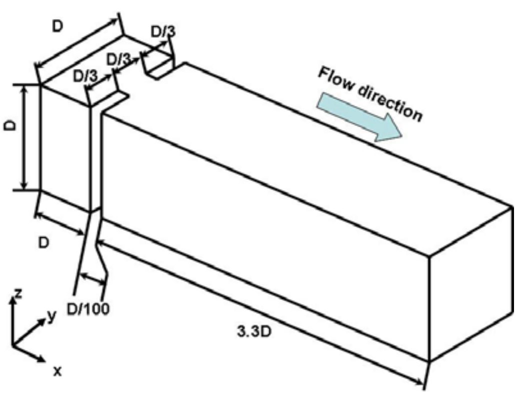

Figure 1: Slit diaphragm in a square duct

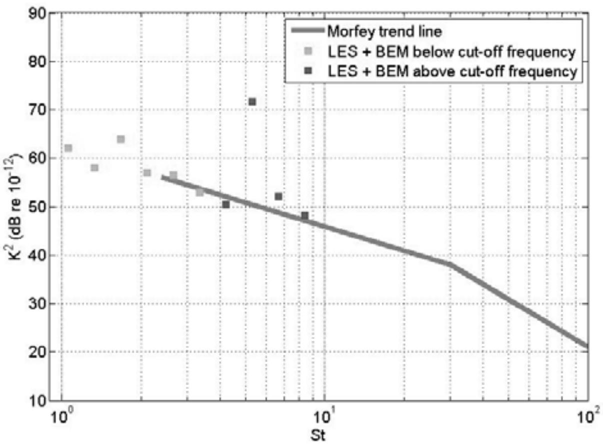

Figure 2: Sound Power level: comparison between experimental and numerical results

[1] Nelson P.A and Morfey C. L., Aerodynamic Sound Propagation In Low Speed Flow Ducts, Journal of Sound and Vibration, 191, v. **79**(2), 263-289