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Validation of a hybrid method of aeroacoustic noise computation applied to internal flows

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A hybrid method of aeroacoustic noise computation based on Lighthill's acoustic analogy is first validated, and then applied to investigate the noise radiated by a low Mach number flow through a diaphragm in a duct. The simulation method is a two-step hybrid approach relying on Lighthill's acoustic analogy, assuming the decoupling of noise generation and propagation. The first step consists in an incompressible Large Eddy Simulation of the turbulent flow field, during which the Lighthill's source term is recorded. In the second step, a variational formulation of Lighthill's Acoustic Analogy using a finite element discretization is solved in the Fourier space.
The validation of this method is briefly presented: a general validation is performed on the case of two corotating vortices in a medium at rest; the exit of turbulent structures from the computational domain is accounted for by a spatial filtering; and a study of spatial interpolation from the CFD mesh to the acoustic mesh shows an acceptable level of error.
This method is applied to a three-dimensional diaphragm with low Mach number flow, showing good agreement with both experimental results and Direct Noise Computation performed by Gloerfelt & Lafon (Computers & Fluids, 2007).