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A finite element method for time harmonic acoustics in arbitrary flows

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The reduction of noise in aeronautics motivates an intensive research in aeroacoustics. In particular, there is a need for efficient tools to simulate acoustic propagation in a mean flow. We are interested here by solving the linearized problem in the frequency domain, by a finite element method able to take into account general geometries and flows. Up to our knowledge, only the potential case has been completely handled.
Recently, a new approach has been developed and validated in the case of a parallel shear flow: it relies on a regularized formulation of Galbrun's equation, well-suited for a discretization by Lagrange finite elements, combined with Perfectly Matched Layers.
A drawback of the method comes from the additional term of regularization, which requires the evaluation of an oscillating integral, coupling all degrees of freedom located on the same streamline. This difficulty can be avoided by replacing this non-local term by its Low-Mach approximation
We show here how to extend this Low-Mach approach to the case of a non parallel flow. Numerical experiments are done. In the case of a potential mean flow, a good agreement with the exact approach is observed, even for quite large Mach numbers.