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Master Thesis 2016-2017 (6 months)

Evaluation of the immersed boundary method for computational aeroacoustics

Summary : Significant progress have been performed over the last two decades in the field of computational aeroacoustics. In particular, the use of high-order low-dispersion and low-dissipation finite differences to solve the compressible Navier-Stokes equations have allowed us to perform accurate simulations of both sound propagation and noise generation problems. However, some difficulties remain.

This is the case for instance when a solid boundary does not conform the (Cartesian) computational grid. To deal with such an issue, immersed boundary (IB) methods have been proposed. They consist in modifying the flow-governing equations or the discretization schemes in the vicinity of the boundary to impose the desired boundary conditions. While they are widely used for incompressible flows, few IB approaches have been developed for compressible flows. Moreover, it is not obvious that they can be implemented successfully in aeroacoustic simulations.

Therefore, the objective of the Master Thesis will be to assess the accuracy and efficiency of the immersed boundary method to properly compute aeroacoustic problems. First, the IB formulations available in the literature will be reviewed. Some of them will be selected, and used to perform 2-D test cases, such as the reflection of an acoustic pulse from a solid wall, aligned or not aligned with the grid, and the impingement of vortices on the wall. The most effective IB method will then used to carry out the simulation of a 2-D noise generation problem (eg noise generated by a flow over a cavity).