Numerical Simulation of Fluid-Structure-Acoustics Interaction

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Noise generation often is caused by turbulent flows or vibrating structures. Various possible interactions between flows, structures and acoustics can result in rather complex multi-physical processes. In this contribution we discuss the challenges related to a fully coupled numerical simulation of such kind of problems. Questions of handling flow-acoustics, structure-acoustics and fluid-structure couplings together with mutual interactions are addressed. As examples, own approaches to deal with these important subtasks are presented.
For fluid-structure interaction an implicit partitioned approach based on the in-house flow solver FASTEST, the structural solver FEAP and the MpCCI coupling interface is considered. The proper involvement of geometrical multigrid methods to achieve a high numerical efficiency is discussed.
For flow-acoustics coupling a numerical scheme based on the ideas of Hardin's and Pope's acoustic/viscous splitting technique is presented. Special emphasis is given to the handling of the very different length and time scales of turbulent flows and the acoustics. As one key issue for handling structure-acoustics coupling the proper treatment of moving grids via an arbitrary Lagrangian-Eulerian (ALE) formulation is discussed.
Results for various test cases are given for verification and validation of the different approaches. Comparative studies illustrate the accuracy and efficiency of the methods. Details about the approaches and the results can be found in [1, 2, 3, 4].

References

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