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An Immersed Boundary Method for the CFD Solver Airbus-CODA

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The Immersed Boundary Method (IBM) [1] is a popular numerical approach to mimic the effect of boundary conditions in the flow without requiring body fitted meshes. IBM reduce considerably the effort of mesh generation and can easily handle moving geometries. In general, the IBM can be achieved by the cut-cell approach or by the introduction of source terms such as the ghost cell, direct forcing or volume penalisation, among others. Volume penalization (VP) [2, 3, 4, 5] belongs to that class of IBM where the governing equations are penalized to drive the flow velocity to specified values (e.g. zero in stationary geometries) in cell points representing the body.

In the present work, we implement and analyse a VP-IBM treatment for the flow simulator Airbus-CODA (CFD for ONERA, DLR, and AIRBUS). VP-IBM has unique advantages, e.g. easy to implement, straightforward formulation to moving boundary problems, and numerical error can be controlled a-priori, showing the potential for aeronautical applications. Numerical experiments will assess the accuracy of the VP-IBM for different geometries and types of discretization methods implemented in CODA.

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