An immersed boundary method for moving bodies in compressible viscous flows

Adrien DORADOUX, Université de Bordeaux

Vincent BRUNEAU, Université de Bordeaux

Pierre FABRIE, Bordeaux INP

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We present a fictitious domain method (see [1], [4]) to treat the displacement of a solid animated by its own velocity v_s in the case where the action of the fluid forces on the body can be neglected. The classical multi-field Navier Stokes equations [2] are considered which introduce volume fractions of phases α_k. The key point of this approach is that no mass is allowed inside the solid domain. It is ensured by modifying the mass balance equation so that the sum of volume fractions $\sum_k \alpha_k$ represents only the geometrical fluid ratio in each cell. A penalization technique is then used to enforce the velocity in the solid region to be v_s in each cell and fluxes are reconstructed on the immersed boundary. Numerical tests are performed with the software Neptune_CFD [3] for incompressible and compressible single phase flows which show good results. Future work will consist in the extension of the method for multiphase flows.

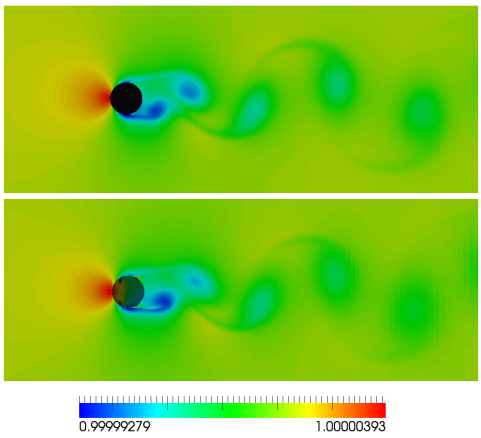

Figure 1: Contour of density for the simulation of a compressible flow around a circular cylinder at $Re = 200$ with Neptune_CFD. The results obtained with our method (below) are compared to a reference case with no-slip boundary condition imposed on the cylinder boundary (above).

Références

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Adrien DORADOUX, IMB, Université de Bordeaux, 351 cours de la libération 33405 Talence
adoradoux@math.u-bordeaux1.fr
Vincent BRUNEAU, IMB, Université de Bordeaux, 351 cours de la libération 33405 Talence
vincent.bruneau@math.u-bordeaux1.fr
Pierre FABRIE, ENSEIRB-MATMECA, 1 avenue du Dr Albert Schweitzer B.P.99 33402 Talence Cedex
pierre.fabrie@math.u-bordeaux1.fr