World Academy of Science, Engineering and Technology
International Journal of Aerospace and Mechanical Engineering
Vol:11, No:05, 2017

Numerical Simulation of Two-Dimensional Flow over a Stationary Circular Cylinder Using Feedback Forcing Scheme Based Immersed Boundary Finite Volume Method

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Abstract : Two-dimensional fluid flow over a stationary circular cylinder is one of the bench mark problem in the field of fluid-structure interaction in computational fluid dynamics (CFD). Motivated by this, in the present work, a two-dimensional computational model is developed using an improved version of immersed boundary method which combines the feedback forcing scheme of the virtual boundary method with Peskin's regularized delta function approach. Lagrangian coordinates are used to represent the cylinder and Eulerian coordinates are used to describe the fluid flow. A two-dimensional Dirac delta function is used to transfer the quantities between the sold to fluid domain. Further, continuity and momentum equations governing the fluid flow are solved using fractional step based finite volume method on a staggered Cartesian grid system. The developed code is validated by comparing the values of drag coefficient obtained for different Reynolds numbers with that of other researcher's results. Also, through numerical simulations for different Reynolds numbers flow behavior is well captured. The stability analysis of the improved version of immersed boundary method is tested for different values of feedback forcing coefficients.

Keywords : Feedback Forcing Scheme, Finite Volume Method, Immersed Boundary Method, Navier-Stokes Equations
Conference Title : ICFMHTT 2017 : International Conference on Fluid Mechanics, Heat Transfer and Thermodynamics
Conference Location : Singapore, Singapore
Conference Dates : May 04-05, 2017