

APPLICATION OF WEIGHTED LEAST SQUARES MESHLESS METHOD TO INCOMPRESSIBLE FLOWS

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Abstract

Meshless methods have been successfully applied to solve a large number of inviscid and viscous compressible flows in both two and three dimensional flow fields. However, the conventional methods of solution for compressible flow equations cannot be applied to incompressible flow equations. This is due to the basic difference in the nature of the pressure variable in the compressible and incompressible flows. Pressure acts as a thermodynamic variable in case of compressible flows and can be easily updated by using the equation of state. In contrast, in case of incompressible flows, the pressure is merely responsible for enforcing the incompressibility constraint and hence cannot be updated by the equation of state. This has led to the development of numerical methods based on Helmholtz Decomposition to solve for the fluid flows in the incompressible flow regimes. Here, we have applied weighted least squares meshless method to solve for the flows in the incompressible flow regime using the projection method based on Helmholtz Decomposition. The standard test cases of two dimensional lid driven cavity flow at Reynolds numbers of 100, 400 and 1000 have been solved using the weighted least squares meshless method. A good match between the results of the test case using the meshless methods and conventional CFD methods for the solution of the incompressible flows has been obtained.

Keywords: Weighted Least Squares Meshless Method, Incompressible Navier Stokes, Helmholtz Decomposition, Lid Driven Cavity Flow