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Finite Volume Method for Flow Prediction Using Unstructured Meshes

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Abstract : In designing a low-energy-consuming buildings, the heat transfer through a large glass or wall becomes critical. Multiple layers of the window glasses and walls are employed for the high insulation. The gravity driven air flow between window glasses or wall layers is a natural heat convection phenomenon being a key of the heat transfer. For the first step of the natural heat transfer analysis, in this study the development and application of a finite volume method for the numerical computation of viscous incompressible flows is presented. It will become a part of the natural convection analysis with high-order scheme, multi-grid method, and dual-time step in the future. A finite volume method based on a fully-implicit second-order is used to discretize and solve the fluid flow on unstructured grids composed of arbitrary-shaped cells. The integrations of the governing equation are discretised in the finite volume manner using a collocated arrangement of variables. The convergence of the SIMPLE segregated algorithm for the solution of the coupled nonlinear algebraic equations is accelerated by using a sparse matrix solver such as BiCGSTAB. The method used in the present study is verified by applying it to some flows for which either the numerical solution is known or the solution can be obtained using another numerical technique available in the other researches. The accuracy of the method is assessed through the grid refinement.

Keywords : finite volume method, fluid flow, laminar flow, unstructured grid
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