Application of an Automatic h-Adaptive Refinement Algorithm in a Second Order Immersed Boundary Code

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Duarte M. S. Albuquerque* and J. C. F. Pereira*

* IDMEC, LAETA, Instituto Superior Técnico (IST), Universidade de Lisboa
LASEF, Department of Mechanical Engineering, Av. Rovisco Pais, 1, 1049-001, Lisbon, Portugal
e-mail: duartealbuquerque@tecnico.ulisboa.pt, web page: http://www.lasef.ist.utl.pt/

ABSTRACT

An automatic adaptive refinement algorithm is an important technique to reduce the computation time while increasing the local accuracy of the numerical simulation. For this goal, the Residual Least Squares (RLS) error estimator has been developed in the Author's own code SOL [1-4], which is suitable for h-adaptive algorithms on unstructured grids.

When applying a h-adaptive algorithm for the case with a complex geometry (curved boundary), special attention is required in order to maintain the grid curvature. For this cases the adaptive grid is dependent of the initial unstructured grid which must be provide by the user or by a grid generator, also keeping a good grid quality is an important issue, during the adaptive refinement.

For this case, an alternative approach is to use an immersed boundary [5] or a cut cell [6] based method, which does not require an initial grid shape, just the domain size must be defined. An immersed boundary has been implemented in the SOL code based on a conservative cut cell approach which maintains the grid quality and the local second order error decay is guarantee by using a least squares method to correct the velocity nearby the complex geometry.

The main objective of the work is to validate the joint techniques of the h-refinement and immersed boundary. The article consists in three parts: the first one shows an example of the adaptive algorithm and error estimator, the second one is the verification of the proposed immersed boundary method based in a conservative cut and the document concludes with an application of an automatic adaptive refinement of the flow around cylinder using the developed immersed boundary method.

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