6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11-15 June 2018, Glasgow, UK

Embedded boundary methods for flow in complex geometries

S. May[1,*] and M. Berger[2]

[1] Department of Mathematics, TU Dortmund, Vogelpothsweg 87, 44227 Dortmund, Germany, sandra.may@math.tu-dortmund.de

[2] Courant Institute of Mathematical Sciences, New York University, 251 Mercer Street, New York, NY 10012, United States, berger@cims.nyu.edu

Keywords: *Cartesian cut cell scheme, embedded boundary grid, finite volume scheme, small cell problem, explicit implicit scheme*

We consider embedded boundary methods in the context of developing finite volume schemes for solving time-dependent, hyperbolic partial differential equations. During mesh generation, an embedded object is 'cut' out of a Cartesian background grid, resulting in so called 'cut cells' along the embedded boundary. As a consequence, most of the grid is regular but special methods must be developed for cut cells. Cut cells can have irregular shape and may be very small. Probably the biggest issue is the so called 'small cell problem' – that explicit time stepping schemes are not stable on the arbitrarily small cut cells.

We present a mixed explicit implicit time stepping scheme for solving the advection equation on a cut cell mesh. We use an implicit scheme near the embedded boundary, and couple it to a standard explicit scheme used over most of the mesh. This way, we overcome the small cell problem while keeping the overall cost low by using an explicit scheme on the majority of the cells. We combine the explicit and implicit scheme by means of 'flux bounding' – this way of coupling preserves mass conservation and ensures stability in form of a TVD result [1].

In this talk, we discuss the latest developments of our scheme; this includes in particular a discussion of which explicit and implicit combinations are most suitable in terms of accuracy and the presentation of numerical results in two and three dimensions.

REFERENCES

[1] S. May, M. Berger, An explicit implicit scheme for cut cells in embedded boundary meshes, *J. Sci. Comput.*, Vol. **71**, pp. 919-943, 2017.