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SEMI-IMPLICIT LEVEL SET METHOD FOR ADVECTIVE AND NORMAL FLOW ON POLYHEDRON MESHES

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In this talk, we would like to propose a second order cell-centered finite volume method to numerically solve an advective and normal flow equation in level set methods on polyhedron meshes. In normal flow equation in [1], an inflow-based gradient approximation is used to properly extend the classical first order method on a regular hexahedron mesh into the second order method in a three dimensional polyhedron mesh. A major drawback in [1] is a CFL time step restriction caused by the explicit time discretization and it is practically crucial issue in many industrial problems. Since a mesh size changes dramatically in a polyhedron mesh of complicated boundary shape, it is inevitable to use very small time step from the CFL condition. In order to overcome the restriction of time step, a semi-implicit method is suggested in [2] for a normal flow equation. The experimental order of convergence (EOC) stays as the second order for chosen examples even if the inner iteration in the semi-implicit method is proceeded only one time. In advective flow equation, we start to check whether the same method in [2] can be applied or not. It turns out that there are few aspects that should be improved. Firstly, the boundary condition on an inflow boundary should be given as a Dirichlet boundary condition. Secondly, the inflow-based gradient should be changed to average-based gradient not because of order of convergence but because of accuracy. Thirdly, it is necessary to use more than one inner iteration in the semi-implicit method to solve the advective equation. Some simple examples are illustrated for advective and normal flow equations on polyhedron meshes.

REFERENCES

[1] J. Hahn, K. Mikula, P. Frolkovič, and B. Basara. Inflow-based gradient finite volume method for a propagation in a normal direction in a polyhedron mesh. *J. Sci. Comput.*, Vol. **72**, pp. 442–465, 2017.

[2] J. Hahn, K. Mikula, P. Frolkovič, and B. Basara. Semi-implicit level set method with inflow-based gradient in a polyhedron mesh. In C. Cancès and P. Omnes, editors, *Finite Volumes for Complex Applications VIII - Hyperbolic, Elliptic and Parabolic Problems*, pages 81–89. Springer International Publishing, 2017.