Smooth level-sets on arbitrary meshes without redistancing

I. Akkerman

Delft University of Technology
Department of Mechanical, Maritime and Materials Engineering
P.O. Box 5, 2600 AA Delft, The Netherlands
E-mail addresses: i.akkerman@tudelft.nl

ABSTRACT

The level-set approach [1] has since its introduction been used in numerous problem settings. One of these application areas is two-fluid flows. Here we present a level-set approach that addresses two issues that can occur when the level-set approach is used to simulate two-fluid flows in engineering practice.

The first issues is that of smoothing of the Heaviside on arbitrary meshes. It is shown that the Heaviside can be non-smooth on non-uniform meshes. Alternative definitions of smoothing, that are indeed smooth and monotonic, are defined. These new definitions lead to smooth Heavisides by taking the changing local meshsize into account.

The second issue is the computational cost and fragility caused by the necessity of redistancing the level-set field. In [2, 3], it is shown that strongly coupling the level-set convection with the flow solver gives robustness and potentially efficiency and accuracy advantages. The next step would be to include redistanc- ing within the strong coupling. Four alternative approaches for circumventing the expensive redistancing step are proposed. Some benchmark cases used to show the efficacy of the proposed approaches. These includes the standard test case of the vortex in a box. Based on these results the most favourable redistancing approach is selected.

REFERENCES

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