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Moment-of-fluid interface reconstruction

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Volume-of-fluid (VoF) methods [2] are widely used in Eulerian simulations of multi-phase flows with mutable interface topology. The popularity of VoF methods is explained by their unique ability to preserves the mass of each fluid component on the discrete level. The strategy of VoF methods consists in calculating the interface location at each discrete moment of time from the volumes of the cell fractions occupied by different materials. Most VoF methods use a single linear interface to divide two materials in a mixed cell (Piecewise-Linear Interface Calculation (PLIC)) [3,4,5]. Once the direction of the interface normal is know, the location of the interface is uniquely identified by the volumes of the cells fraction. Unfortunately the interface normal can not be evaluated without the volume fraction data from the surrounding cells, which prohibits the resulting approximation to resolve any interface details smaller than a characteristic size of the cell cluster involved in evaluation of the normal.

To overcome this limitation, we designed a new *mass-conservative* interface reconstruction metho [1], which calculates the interface based on both *volumes and centroids* of the cell fractions. This choice of the input data allows to evaluate the interface normal in a mixed cell *even without the information from the adjacent elements*. The location of the linear interface in each mixed cell is determined by *fitting the centroid of the cell fraction behind the interface to the reference one*, which leads to $(d-1)$-variate optimization problem in $\mathbb{R}^d$. The technique proposed, called Moment-of-Fluid (MoF) interface reconstruction, results in a *second order accurate* interface approximation (linear interfaces are reconstructed exactly), has higher resolution, and is shown to be *more accurate than VoF-PLIC methods*.

We present a detailed description of MoF interface reconstruction algorithm in 2D, which includes iterative procedure for centroid fitting and a new algorithm for cutting appropriate volume fractions from polygonal cells.

REFERENCES

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