Geometrical Interface Reconstruction on Arbitrary Meshes

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A purely geometrical method is developed to construct material interfaces on arbitrary meshes using volume fractions. The method is an extension of the Youngs method on regular meshes. The orientation and slope of the interface facets contained in mixed cells are obtained by properly marking nodes of cells and matching volume fractions in neighbour cells. A simple, universal rule for defining the topology of intersections between arbitrary shapes is used to define the facets. Instead of the planar facets used in Youngs method, the new method derives the shape of a facet based on volume fractions therefore improves connectivity of the interface across cell walls. Curvature of the interface is then naturally obtained. Thus, the new method improves the accuracy of Youngs method by an order. In principle, corners can be detected by extrapolating facets around potion of the interface with large curvature, then adjusted according to the volume fractions.

Under the assumption that an accurate initial interface geometry is available. One is able to track the interface geometry over each time step and use the new method to match volume fractions to fine tune the interface geometry. Change of interface topology is detected by looking for neighbouring facets with considerably different slopes.

With the help of this geometrical method, the difficulties with disjoint facets across cell faces and T/Y intersections in Youngs method may be effectively dealt with.