A Hybrid Particle Level Set Method for Improved Interface Capturing

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In this talk, we present a new numerical method for improving the area (volume) conservation properties of the level set method when the interface is passively advected in a fluid flow field. Our method incorporates the use of Lagrangian marker particles to rebuild the level set in regions of the flow which are under-resolved. This is often the case for flows undergoing stretching and tearing. The overall method maintains a smooth geometrical description of the interface and the simplicity of implementation present in the level set method. Our method compares favorably with volume of fluid methods in the conservation of mass and purely Lagrangian schemes for interface resolution in highly vortical flows. The method is presented in three spatial dimensions, with numerical examples in two and three spatial dimensions. This work is a collaboration between Doug Enright, Ron Fedkiw, Joel Ferziger, and Ian Mitchell.