OCTREE BASED METHOD FOR INCOMPRESSIBLE FREE SURFACE FLOWS.

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ABSTRACT

An efficient method for incompressible free surface flows is presented. The usual way to solve such problems is to use fully implicit method with numerous nested loops [1], but we present a projection method, that is much less computationaly expensive [2,3]. The method is based upon the particle level set method for surface representation and the use of adaptively refined meshes built on enhanced octree data structure.

The level set method provides accurate representation of the interface, yet can cause noticeable mass loss in case of water drops and splashes. On the contrary, the use of massless marker particles alone makes the surface noisy. By combining these two techniques we correct smooth level set representation to preserve the mass of the liquid.

High surface resolution within limited amount of cells is achieved by using octree based MAC (Marker-And-Cell) grids. We use mesh refinement techniques to capture the small scale details of the surface. The use of octree structure for computational meshes results in certain problems, that were to be solved:

1. Firstly a fast faces-to-nodes interpolation algorithm was needed. So we designed horizontal links which can be rapidly reconstructed and an algorithm to populate nodal values.

2. Secondly basic differential operators were to be reconsidered to fit nonconformal meshes. Special discretization of gradient and laplacian operators on the octree mesh was proposed.

Difficulties associated with numerical diffusion are removed by using the semi-Lagrangian characteristic tracing technique to advect the velocity and the level set. It makes implementation on an octree straightforward. Computationally expensive high order accurate schemes are not required in this method.

REFERENCES

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