

A Fast and Stable Gas-Liquid-Solid Three-Phase Flow Simulation and Visualization on multiple GPUs

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An integrated numerical simulation for gas-liquid-solid three-phase flow and visualization system has been developed on GPU (Graphics Processing Unit), by making best use of parallel computation power and fast and high quality visualization capability. Our computation scheme for multiphase flow is based on VoF (Volume of Fluid) method for highly accurate advection with excellent volume conservation, and VSIAM3 for complete suppression of numerical oscillation. Both methods have been effectively implemented on multiple GPU environment for fast computation. One of the big advantages of our implementation is that it only requires single precision floating numbers by using the efficient preconditioning method for enhanced Krylov subspace method, while most other implementations require double precision numbers or even quad precision numbers for good convergence of Poisson solvers. Various examples of interacting gas, liquid and solid will be shown in the full paper for demonstration of the excellence of our scheme and GPU implementation.

Keywords: CFD, Gas-Liquid-Solid Three-Phase Flow, GPU, Real-time Visualization, Multi-Physics Simulation