# A Two-phase Flow Simulation based on Weakly Compressible Flow Scheme coupled with Conservative Phase-Field Method

**Shintaro Matsushita***, **Takayuki Aoki**†

* Tokyo Institute of Technology
2-12-1 i7-3 O-okayama, Meguro-ku, Tokyo
e-mail: matsushita@sim.gsic.titech.ac.jp

† Tokyo Institute of Technology
2-12-1 i7-3 O-okayama, Meguro-ku, Tokyo
e-mail: taoki@gsic.titech.ac.jp

## ABSTRACT

In incompressible flow computations using semi-implicit time integration, the Poisson solver is a major time consuming. Especially the iteration has a poor convergence for gas-liquid two-phase flows in the case of large-scale problems. Without solving the Poisson equation, we have developed a computational method for weakly compressible flow to solve low Mach number gas-liquid two-phase flows with explicit time integration. The scheme is coupled with the conservative phase-field method[1] as an interface capturing method. To increase the computational efficiency, we introduce a directional splitting technique and apply the method of characteristics. The phase-filed equation is solved by directional splitting with the multi-moment IDO scheme[2], which guarantees the mass conservation and maintains the width of gas-liquid interfaces by the anti-diffusion term. Our method is suitable for adaptive mesh refinement (AMR) and large-scale computatipn. Several benchmark problems have been examined and the results are in good agreements with the experimental and referenced computational data.

We demonstrate some numerical simulations in Fig.1. Fig.1 (a) shows the results of a bubble rising, milk crown Fig.1 (b) ($287 \times 297 \times 108$ meshes) and a dam breaking problem launching into a wet floor ($576 \times 96 \times 288$ meshes) shown in Fig.1 (c).

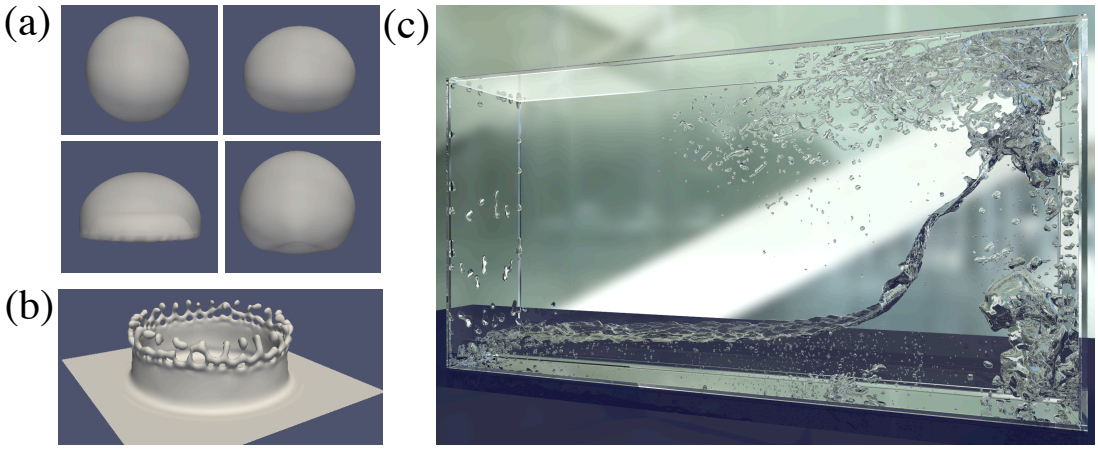


**Fig 1**: Some numerical results, (a) bubble rising in some cases, (b) milk crown simulation, (c) dam breaking problem.

## REFERENCES

[1] Chiu, P-H. and Lin, Y-T, *A conservative phase field method for solving incompressible two-phase flows,* J. Comput. Phys., Vol. 230(2011), pp. 185-204.

[2] Y. Imai, T. Aoki, and K. Takizawa, *Conservative form of Interpolated differential operator scheme for compressible and incompressible fuid dynamics,* J. Comput. Phys., 227(4)(2008), pp.2263-2285.