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Improved wall boundary conditions with implicitly defined walls for particle based fluid simulation

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We developed boundary conditions for particle based fluid simulation. As a particle simulation method, moving particle semi-implicit [1] is employed, and all wall shapes are defined by implicit function form. In existing particle based fluid simulation methods for implicit function form [2], boundary conditions are formulated by assuming wall particles are arranged along flat planes. This assumption, however, causes particle clustering near walls and inaccurate pressure distribution.

We addressed this problem by considering contributions of non-planar wall shapes. In order to evaluate the contributions of non-planar boundary conditions, dummy particles are arranged around the walls in polygon wall boundary models [3]. We uniformly distributed dummy particles around the implicitly defined wall boundaries using the characteristics of implicit function form. The dummy particles are used only for precomputation, therefore no dummy particles are needed at the time of actual simulation.

Since our proposed method takes the non-planar boundaries into account, wall weight functions are more accurately evaluated, and as a result, unnatural fluid behavior around walls are improved. Our test results show that the unnatural clustering and inaccurate pressure distribution are enhanced by our proposed method.

REFERENCES

[1] S. Koshizuka and Y. Oka, Moving-particle semi-implicit method for fragmentation of incompressible fluid. *Nuclear Science and Engineering*, Vol. **123**, Issue 3, pp. 421–434, 1996.

[2] S. Nakata and Y. Sakamoto, Particle-based parallel fluid simulation in three-dimensional scene with implicit surfaces. *Journal of Supercomputing*, Vol. **71**, Issue 5, pp. 1766–1775, 2015.

[3] T. Zhang, S. Koshizuka, K. Murotani, K. Shibata, E. Ishii and M. Ishikawa, Improvement of boundary conditions for non-planar boundaries represented by polygons with an initial particle arrangement technique. *International Journal of Computational Fluid Dynamics*, Vol. **30**, Issue 2, pp. 155–175, 2016.