An improved finite particle method for modeling natural convection problems

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ABSTRACT

The finite particle method (FPM) [1, 2] is a modified SPH method [3], which is computationally more accurate and more stable than the conventional SPH method. However, when simulating natural convection problems with FPM, numerical oscillations may occur if the smoothing length is larger than the initial particle spacing. In this paper, an improved FPM is developed, which adopts a symmetrizing discretization schemes of the first-order derivatives and replaces the discretization schemes of the second-order derivatives with the method proposed by Monaghan for higher stability. To further improve numerical stability, the particle-shifting technology is applied. The presented improved finite particle method is then used to model the shear driven cavity problem at different Reynolds numbers and a natural convection problem at different Rayleigh numbers. The obtained numerical results agree well with results from other sources, and this clearly shows the effectiveness of the improved finite particle method.

REFERENCES

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