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Some Investigations of a Time-explicit Generalized Particle Method for the incompressible Navier–Stokes Equations

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We have recently obtained error estimates of a generalized particle method for convection-diffusion problems and some approximate operators (see, for example, [1], [2], and [5]), and have now continued to estimate the method for the incompressible Navier–Stokes equations.

When introducing an implicit scheme in time based on the predictor-corrector method for the incompressible Navier–Stokes equations, we need to solve the pressure Poisson equation at each time step. However, solving the pressure Poisson equation causes the increasing of computational costs. Therefore, some researchers introduce explicit schemes in time based on the equation of state; see, for example, [3] and [4].

First we introduce a new explicit scheme in time of the generalized particle method for the incompressible Navier–Stokes equations, which is regarded as a discretization of the compressible ones. Second we give some remarks on the relations among our time-explicit scheme, the incompressible Navier–Stokes equations, and the compressible ones. Finally we show some numerical results on the stability and convergence of the method.

REFERENCES

[1] Imoto, Y. and Tagami, D.: Truncation error estimates of approximate differential operators of a particle method based on the Voronoi decomposition, *JSIAM Letters*, **9** (2017), pp.69–72.

[2] Imoto, Y. and Tagami, D.: A truncation error estimate of the interpolants of a particle method based on the Voronoi decomposition, *JSIAM Letters*, **8** (2016), pp.29–32.

[3] Monaghan, J.J.: Simulating free surface flows with SPH, *J. Comput. Phys.*, **110** (1994), pp.399–406.

[4] Shakibaeinia, A. and Jin, Y.-C.: A weakly compressible MPS method for modeling of open-boundary free-surface flow, *Internat. J. Numer. Methods Fluids*, **63** (2010), pp.1208–1232.

[5] Tagami, D.: Mathematical analysis of characteristic generalized particle methods for convection-diffusion equations, *Proceedings of the 12th International SPHERIC Workshop*, Ourense, Spain, June 12–15, 2017.