Usage Report for Fiscal Year 2022

Project Title:

Multiscale modeling of ultrasonic-controlled drug delivery system processing

Name:

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1. Background and purpose of the project, relationship of the project with other projects

We consider an oscillatory spherical bubble travelling in shear-thinning power-law fluid and investigate the effects of the oscillatory frequency on the fluid behaviors induced by the oscillatory spherical bubble. Our results shed light on the dynamics of bubbles in shear-thinning fluid with occurrence of ultrasonic irradiation.

2. Specific usage status of the system and calculation method

(1) Specific usage status of the system

Numerical simulations of the shear-thinning fluid flow induced by an oscillatory spherical bubble

(2) Calculation method

The numerical simulation predicts the fluid behaviors of the flow induce by a translational oscillatory spherical bubble and the viscosity of the fluid is constrained by power-law model. To exactly impose the boundary condition and to exactly evaluate the fluid force acting on the bubble, the governing equations are described by a spherical coordinate system, and discretized in a finite-difference scheme. Thread parallelization (OpenMP) is applied to all the loop operations over the entire grid points in the code.

3. Result

(1) For the strong shear-thinning fluid, the oscillation amplitude has more significant influences on the velocity of the fluid than the angular frequency.

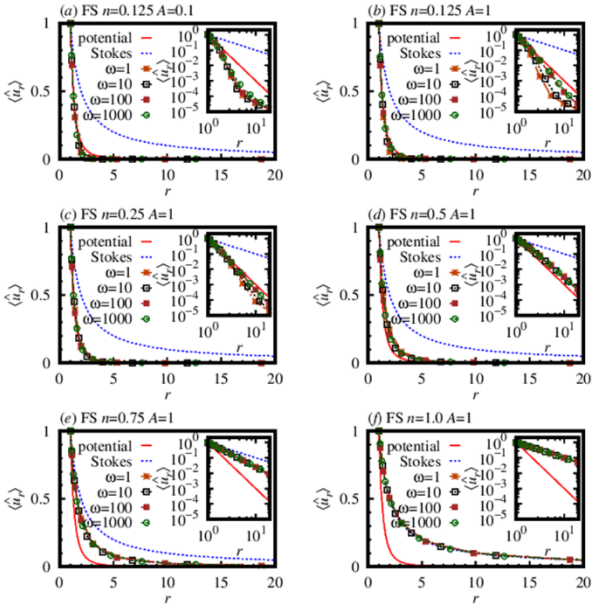

Figure1 The time-averaged velocity coefficient

4. Conclusion

The oscillation amplitude has more significant influences on the velocity of the fluid than the angular frequency.

5. Schedule and prospect for the future

The future plan for FY2023: We will investigate the drag reduction effect of ultrasonic irradiation on a sphere freely falling in shear-thinning fluid in FY2023.

Fiscal Year 2022 List of Publications Resulting from the Use of the supercomputer

[Paper accepted by a journal]

1. Drag force on an oscillatory spherical bubble in shear-thinning fluid. *Journal of Fluid Mechanics*. (Accepted)