【Special Program in Applied Mathematics and Applied Mechanics】

A 3D immersed boundary method for non-newtonian-fluid-structure interaction with applications

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Fluid-structure-interaction (FSI) is complex and challenging to model and simulate, and it is still an area of active research. Motivated by FSI phenomena in life sciences (e.g., motions of sperm and cytoskeleton in complex fluids), we introduce a new immersed boundary method for FSI problems involving non-Newtonian fluids in three dimensions. The non-Newtonian fluids are modelled by the power law or the FENE-P model. The fluid flow is modelled by the lattice Boltzmann equations (the D3Q19 model). The deformable structure and the fluid-structure-interaction are handled by the immersed boundary method. As applications, we consider two toy FSI problems --- an elastic sheet fixed at the midline interacting with a flowing power-law fluid and an elastic sheet being towed constantly or flapped sinusoidally in a still FENE-P fluid in three dimensions.