Parallel Strong Coupling Method for Interaction of Incompressible Viscous Fluid and an Elastic Body with Finite Deformation

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This paper describes a parallel strong coupling method for interaction of incompressible viscous fluid and an elastic body with finite deformation. The method is based on a multi-steps strong coupling method proposed by authors [1], in which the auxiliary Poisson equation for the fluid pressure field is developed and a conjugate gradient (CG) method is employed to solve the simultaneous equations. In implementing the proposed method, the Arbitrary Lagrangian Eulerian (ALE) method is utilized to account for the deformable fluid domain, while the total Lagrangian method is utilized to account for the finite deformation of the elastic body with small strain. The method is parallelized using a domain decomposition method with the element-by-element approach, then the proposed method is implemented on PC-cluster system (PCs: DualAthlonMP1700×16, Network: 1000BaseGbitEthernet). To demonstrate basic characteristics of the proposed method, it is applied to the problem of vibrating behavior of a loaded cantilever in water. Through the test problem, the parallel efficiency, the effect of the mesh scale, and the effect of the finite deformation are discussed.

References

[1] D. Ishihara, S. Yoshimura, G. Yagawa, Multi-steps strong coupling method for interaction of incompressible viscous fluid and an elastic body. Fifth World Congress on Computational Mechanics 2002, v.2, p.258, 2002.