Fluid-structure Interaction Analysis with Minimum-height-based Mesh Moving Technique

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Abstract: This paper describes performance study of a mesh moving technique with minimum-height-based stiffening for robust fluid-structure interaction (FSI) analysis with large deformation. The authors have been developing a general purpose parallel FSI analysis system for large scale problems with interface tracking approach and applied it to the analyses of flapping motion of micro air vehicles, fuel assemblies of the boiling water reactors under seismic loading, wind turbines and so on. The practical use of FSI analysis system requires the robustness for the parametric design of various mechanical systems. In this context, mesh moving technique is a key for avoiding the failure of the analysis due to the mesh distortion. Hence, we have proposed a new mesh moving technique, minimum-height-based stiffening technique, where the mesh deformation of the fluid domain is virtually governed by the linear elastic equations and the stiffness of each element is determined according to its minimum height. In this paper, the proposed technique is applied to two-dimensional FSI problem of flapping motion. The results were compared with those with Jacobian-based stiffening technique, which is one of the most effective approaches of mesh moving techniques. Finally, the proposed technique shows better performance, i.e., the improvement of a mesh quality factor and detailed distortion of mesh during the FSI analysis is discussed.