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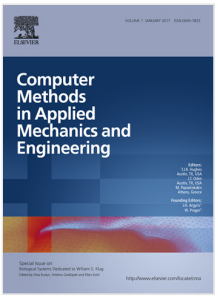

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An accurate and efficient scheme for acoustic-structure interaction problems based on unstructured mesh

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Abstract

This paper focuses on the accurate and efficient numerical implementation of acoustic-structure coupling formulations using the edge-based smoothed finite element method for the flexible shell and the gradient-weighted finite element method for the acoustic fluid field, namely, the ES/GW-FEM. The shell is discretized using the simplest linear triangular elements and the edge-based smoothing domain is then constructed. By introducing an edge local coordinate system, the edge-based smoothing operation is performed on the smoothing domain. As for the acoustic fluid domain, the tetrahedron elements are adopted. A compacted support domain is then constructed and the gradient weighted operation is performed on the support domain. To model the exterior acoustic domain, an artificial boundary is introduced and the Dirichlet-to-Neumann (DtN) boundary condition is imposed. Based on the appropriate compatibility and equilibrium conditions on the interface boundaries, the coupled ES/GW-FEM formulation is finally obtained. Both the interior acoustic-structure coupled problems and exterior acoustic-structure coupled problems are available as the DtN boundary is considered. Numerical examples demonstrate that the coupled ES/GW-FEM achieves much higher accuracy and works more reliable compared with the coupled FEM/FEM in solving practical engineering problems.

Keywords: Acoustic; shell structure; acoustic-structure interaction; numerical methods; the edge-based smoothed finite element method (ES-FEM); the gradient-weighted finite element method (GW-FEM).

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