Edge-Based Smoothed Finite Element Modeling and Analysis of Two-Dimensional Complex Elastic Cavities Postprint

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Abstract

Applying passive constraint layer damping (PCLD) to elastic cavity structures can achieve vibration and noise reduction effects. A two-dimensional coupled dynamic model for composite elastic cavities based on the edge-based smoothed finite element method was established for such complex structures. In this model, the PCLD structure was simulated using two-node four-degree-of-freedom PCLD beam elements, while the acoustic field was modeled using an edge-based smoothed finite element model. Employing a two-dimensional fully-covered composite rectangular cavity model as a numerical example and utilizing finite element method results under refined mesh as reference solutions, a comparative study was conducted on the frequency response results obtained by the edge-based smoothed finite element method and the conventional finite element method under identical background meshes. The results demonstrated that the former approach yields solutions closer to the reference solution, indicating that the edge-based smoothed finite element method achieves higher accuracy under equivalent computational cost, particularly in mid-frequency calculations. Finally, the noise reduction effectiveness of PCLD structures on an automobile cabin was analyzed, along with the influence patterns of viscoelastic layer and constraining layer thickness parameters. It was found that increasing viscoelastic layer thickness can reduce cavity noise to a certain degree, whereas increasing constraining layer thickness does not yield satisfactory noise reduction effects across the entire frequency band.

Full Text

Preamble

The original text in this section is heavily corrupted and cannot be reliably recovered. Only the following mathematical expressions have been preserved from the source material:

MATH_{0001}

$$ZLE6 <>$$

$M^3 * b; 5$ MATH_{0003}

MATH_{0009}

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[Remaining content is too corrupted for meaningful recovery.]

Note: Figure translations are in progress. See original paper for figures.

Source: ChinaXiv — Machine translation. Verify with original.