Recent Advances in the Scaled Boundary Finite Element Method (Postprint)

Authors: Zhang Junqi, aftermath, Song Chongmin, Junqi Zhang

Date: 2022-12-21T00:00:00+00:00

Abstract

With the advancement of computer technology, numerical computational methods have been widely applied in the engineering field. The Finite Element Method (FEM), as a typical representative among them, has developed into mature commercial software. However, existing finite element methods still exhibit certain limitations in infinite domain dynamic response problems, stress concentration problems, and automated mesh generation. Moreover, rapidly evolving modeling technologies have introduced a large number of new geometric model formats, such as electronic scanning images, 3D printing models, point cloud models, etc., all posing new challenges to numerical simulation. The Scaled Boundary Finite Element Method (SBFEM), as a novel semi-analytical numerical method, integrates the advantages of the Finite Element Method (FEM) and the Boundary Element Method (BEM), performing discretization only on element surfaces while employing analytical solutions within element interiors, thereby reducing the problem dimension by one. It possesses unique advantages in handling infinite domain dynamic problems and stress concentration problems with singularities. SBFEM elements only need to satisfy visibility requirements, which enhances element shape flexibility and allows the construction of polygonal and polyhedral elements containing arbitrary numbers of nodes. Combined with efficient automated mesh generation algorithms such as octree, it can achieve seamless integration with various geometric models and is suitable for large-scale parallel computing. In recent years, SBFEM has developed into a universal and efficient computational tool capable of meeting the demands of modern engineering computations, demonstrating tremendous application prospects in infinite domain dynamic problems, fracture mechanics, nonlinear problems, contact, adaptive analysis, inverse problems, multi-field coupling, high-performance computing, and other areas. This study focuses on systematically reviewing the development history and recent research hotspots of SBFEM, and looking forward to future development trends, providing references for researchers and engineering technicians in related fields.

Full Text

Preamble

[The following text is severely corrupted and consists primarily of encoding artifacts, corrupted LaTeX commands, and unreadable character sequences. No meaningful Chinese content can be extracted for translation.]

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