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A New Polygonal Scaled Boundary Finite Element Method Using Exact NURBS Boundaries

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ABSTRACT

Aiming to address the challenge of inaccurately describing the curve boundary of the complex design domain in traditional finite element mesh, this work proposes a new polygon mesh generation and polygonal scaled boundary finite element method (SBFEM) using exact non-uniform rational B-splines (NURBS) boundaries. The NURBS curve information of the boundary can be adaptively updated with mesh changes. Using SBFEM, the boundary elements can be discretized into NURBS elements and conventional elements, whose physical fields are respectively constructed using NURBS basis functions and Lagrange shape functions in the circumferential direction. Furthermore, in the radial direction, by transforming a system of partial differential equations into a system of ordinary differential equations, which can be analytically solved without fundamental solutions. The numerical examples demonstrate that the proposed method can achieve a high-quality polygonal mesh with adaptive NURBS updating. Moreover, it effectively solves the corresponding polygonal elements and significantly improves the accuracy of the displacement and stress solutions compared to the traditional polygon SBFEM.

KEYWORDS

NURBS boundary; polygon mesh; SBFEM; adaptive; complex design domain

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