A Mixed cover meshless method for elasticity and fracture problems

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A Mixed cover meshless method for elasticity and fracture problems

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Abstract: A mixed cover meshless method (MCMM) is developed to solve elasticity and fracture problems. In this technique, an arbitrary computational geometry is discretized using regular square cells, and meshless approximation functions are separately defined at the interior and boundary square cells using the concept of independent nodal covers and overlapping nodal covers, respectively. For the fracture analysis, a set of triangular independent nodal covers around a crack tip is employed, and the virtual crack closure technique (VCCT) is used to calculate the crack-tip stress intensity factors (SIFs). The overlapping nodal covers and independent nodal covers can be freely selected and converted as required during the simulation process of crack growth, and the square cells near geometry boundaries, such as material discontinuities, crack lines, or crack tips, can be further subdivided by quadtree decomposition to perform *h*-adaptivity analysis and to achieve the desired solution accuracy. The MCMM gets rid of the need for generating conforming meshes in the finite element method (FEM), possesses the merits of a concise formulation of interpolation functions, simple numerical implementation and convenient simulation of crack growth along arbitrary directions, and improves the computational efficiency compared to classic meshless methods such as the element-free Galerkin method (EFGM) and the meshless method based on Shepard function and partition of unity (MSPU). Several representative elasticity and fracture examples demonstrate the convergence, accuracy, and robustness of the present method.

Keywords: *Meshless; Mixed cover; Independent cover; Overlapping cover; Crack propagation; Quadtree*

1. Introduction

As a powerful numerical analysis tool, the finite element method (FEM) has been widely used for engineering analysis and scientific research. Mesh generation and element-based interpolation provide the theoretical foundation for the implementation and development of the traditional FEM, but they