Tech Science Press

ICCES, 2024, vol.30, no.2
DOI: 10.32604/icces.2024.011251

CORRECTION

Correction: A "Parallel Universe" Scheme for Crack Nucleation in the Phase Field Method for Fracture

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ABSTRACT

The phase field method for fracture has become mainstream for fracture simulation. It transforms the crack nucleation problem into a minimization problem of the sum of the elastic potential energy and the crack surface energy. Because of the biconvexity of its energy functional, there is an energy barrier between local minima with and without a crack, resulting it difficult for standard methods, such as the Newton method, to converge to a cracked solution when starting from a solid without crack, especially when the material and the geometry are uniform, even if current cracked solution with cracks has a lower energy. Here, we propose an algorithm termed the "parallel universe" scheme [1] to capture the global minimum. This algorithm has two key ingredients: (a) a necessary condition for cracking based on the current uncracked solution, and (b) beginning from when this condition is met, Newton iteration with two initial guesses, an uncracked one and a cracked one, will both be performed and the converged candidate solution with lower energy is accepted as the solution at that load step. Once the cracked candidate solution is accepted, the uncracked one is discarded, i.e., only one "universe" is retained. This cracked initial guess is obtained only once for all load steps by solving a series of similar minimization problems with a progressively reduced critical crack energy release rate. Numerical examples with isotropic and anisotropic critical crack energy release rates indicate that the proposed algorithm is more reliable (as there is no need to retrace) and more efficient than the standard Newton iteration and a well-known backtracking algorithm [2].

KEYWORDS

Phase field method for fracture; global minimization; crack nucleation

Funding Statement: We acknowledge the financial support by the National Natural Science Foundation of China, Grant No. 11972227, and by the Natural Science Foundation of Shanghai, China, Grant No. 19ZR1424200.

Conflicts of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.

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