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Invited Paper

An acceleration scheme for the phase field fatigue fracture simulation with a concurrent temporal homogenization method

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ABSTRACT

The fatigue fracture accounts for severe mechanical failures. In recent years, the phase field approach for fracture has been adapted for fatigue fracture. In this study, we propose an efficient acceleration scheme for the phase field approach based on a concurrent time-scale homogenization theory. In this scheme, the fatigue fracture problem is decomposed into a macrochronological problem and a microchronological problem, and is accelerated with the macrochronological time steps adaptively determined. Throughout the whole simulation, the macrochronological time step is monitored, and is corrected by a predictor-corrector strategy if necessary. This scheme is able to accelerate fatigue fracture simulations without sacrificing much accuracy, and can be up to 200 times faster than direct numerical simulations in some cases. For certain force-controlled examples, the proposed scheme, equipped with the arc-length control, is able to reproduce Paris' law with a correlation coefficient higher than 0.91 in the logarithmic scale.

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