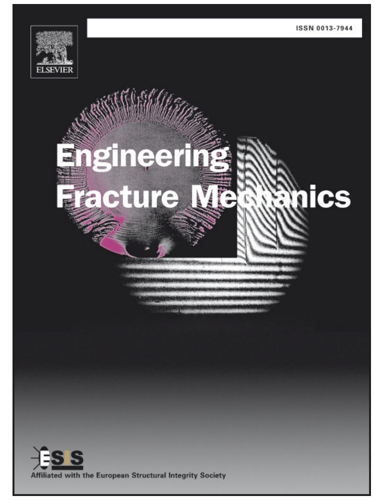

On the Application of Multipoint Root-Solvers for Improving Global Convergence of Fracture Problems

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On the Application of Multipoint Root-Solvers for Improving Global Convergence of Fracture Problems

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Abstract

Achieving accelerated global convergence of finite element analysis is advantageous especially when implementing complex fracture models. This exploratory study investigates the performance of cubic, fourth order and fifth order multipoint root-solvers that require only first order derivatives for solving the nonlinear equations encountered in the global finite element problem in the context of fracture analysis. To this end, influence of various parameters – including number of loading steps, problem size and convergence criterion used while implementing a typical fracture model (Gurson model) – on the computational time, rate of convergence and number of iterations consumed by various higher order root-solvers is studied. Although with an additional computational overhead, the higher order root-solvers exhibited superior convergence rates and consumed less number of global iterations when compared to the Newton Raphson method during fracture analysis. In addition, new hybrid root-solvers are introduced to alleviate the convergence issues encountered in fracture analysis to accelerate the performance of higher order root-solvers.

Keywords: Gurson model; Multipoint methods; Root-solvers; Higher order convergence; Nonlinear equations.

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