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Modelling hydraulic fracture propagation with extended finite element method

Tao Wang [1]*, ZL Liu[1] and Z Zhuang[1]

Scholl of Aerospace, Tsinghua University Beijing 100084, China
[1] wangtao3924@163.com

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Hydraulic fracturing is a very important technology for shale gas or shale oil drilling engineering. The numerical simulation is one of the key methodologies for developing hydraulic fracture technology. A new method for modelling hydraulic fracture propagation is developed in this paper. The extended finite element method is modified with phantom node method and implemented into ABAQUS with user subroutine VUEL. The phantom node method simplifies the treatment of element-by-element crack in explicit methods.[1] A quadrature method for 8 node hexahedron element is proposed based on a single quadrature point and hourglass control so we can improve the efficiency of the program. A fully coupled numerical model is developed by solving the fluid control equation and solid momentum equation simultaneously, thus that we can veritably simulate the hydraulic fracture. The results of numerical simulation and experiment have been compared, which are illustrated the coupled physical processes, i.e. the solid skeleton deformation, the fluid flow in the fracture and the hydraulic fracture propagation. Consequently, it is very important to provide an appropriate solution for the problem of hydraulic fracture in the shale formation.

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