

A Fully Coupled Finite Element/Finite Volume Method for the Massively Parallel Simulation of Hydraulically Driven Fractures in 3-Dimensions

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This presentation will describe a fully coupled finite element/finite volume approach for simulating problems involving field-scale hydraulically driven fractures in three dimensions utilizing massively parallel computing platforms. A detailed description of the governing equations, and numerical implementation is provided, including a discussion on assumptions to ensure a well-posed problem. In particular, methods to avoid numerical issues associated with the near tip-region will be discussed. We will outline different integration strategies (explicit/implicit) for solving the fully coupled system, including a comparison of computational effort associated with the options. The challenges of handling changes in mesh topology in a massively parallel distributed-memory computing environment will be discussed.

A series of numerical studies comparing the model to both analytical solutions and experimental results will be presented. The choice of a Finite Element Method allows the proposed method to provide a reasonable representation of local heterogeneities, layering, and natural fracture networks in a reservoir. To illustrate the flexibility and effectiveness of the proposed approach when applied to real-world problems, several field scale case studies will be presented.

Keywords(optional):hydraulic fracturing, fracture mechanics, high performance computing