11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

CHALLENGES IN THE SIMULATION OF HYDRAULIC FRACTURE NETWORKS IN THREE DIMENSIONS USING MASSIVELY PARALLEL COMPUTING PLATFORMS

Randolph R. Settgast[1], Scott M. Johnson[1], Pengcheng Fu[1], Stuart D. C. Walsh[1], and Joshua White[1]

[1] Lawrence Livermore National Laboratory, 7000 East Ave., Livermore, CA 94550,
settgast1@llnl.gov

Key Words: *Hydraulic Fracture, Parallel Computing, Fluid-Structure Interaction*

Hydraulic fracturing has been an enabling technology for commercially stimulating fracture networks for over half of a century. It has become one of the most widespread technologies for engineering subsurface fracture systems. Despite the ubiquity of this technique in the field, understanding and prediction of the hydraulic induced propagation of the fracture network in realistic, heterogeneous reservoirs has been limited. A number of developments in multiscale modeling in recent years have allowed researchers in related fields to tackle the modeling of complex fracture propagation as well as the mechanics of heterogeneous materials. These developments, combined with advances in quantifying solution uncertainties, provide possibilities for the geologic modeling community to capture both the fracturing behavior and longer---term permeability evolution of rock masses under hydraulic loading across both dynamic and viscosity--- dominated regimes. Here we will discuss the various challenges associated with performing tightly coupled hydromechanical Finite Element/Finite Volume simulations of hydraulically induced fracture network propagation at massively parallel computing scales. Furthermore, we will discuss validity of various assumptions in fracture mechanics, fluid mechanics, as well as mesh topology change in parallel computing environments, and the solution of the poorly conditioned systems that result from the coupled hydro---mechanical equations. We will present studies that compare with analytical solutions as well as hydraulic fracturing simulations at field scale.

This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE---AC52---07NA27344.

REFERENCES