On the development of a hydraulic fracturing simulator

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Abstract

The economic feasibility of exploiting the resources of unconventional oil and gas increases when it is possible to analyze a priori with reasonable accuracy, the effects of different schemes of hydraulic fracturing, of different fracturing fluids, of different proppant additions and of different well patterns, and compare these results in terms of the expected production. The basic ingredients for these analyses are a reliable numerical technique and an adequate geomechanical characterization of the formations to be fractured.

A simulation technique adopted for modeling the hydraulic fracturing process, based on the Discontinuous Galerkin Method [1] [2] [3] [4], is discussed in this paper. This technique is being implemented to simulate the hydraulic fracturing of shale reservoirs using very large models that can be efficiently processed resorting to parallel computing. It is important to remark that the resulting models incorporate the proper fracture mechanical concepts required to simulate the fractures nucleation and propagation.

As intermediate steps for the validation of the new simulator the results of several well-known benchmarks are discussed: the Brazilian Test (fracture nucleation) and the Brazilian Test with a slot (fracture propagation).

It is also demonstrated that the simulator can detect elastic waves induced by the fracturing process, opening the possibility of validating the numerical results using microseismic records obtained in the field.

The other important phenomenon that it is included in the simulation is the flow of the fracturing fluid in the fractures that it open; the fluid and the solid problems are coupled and the simulator properly incorporates this fundamental feature of the model.

References

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