Genetic-based Characterization of Fractured Reservoirs from Interpreted Well Tests

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Abstract

The presence of fractures at various scales affects the flow dynamics within a reservoir, thus casting uncertainty on the assessment of the field productivity and reserves. Methodologies and tools are available (i) to construct geologically-realistic models of the fault/fracture network (ii) to turn these models into simplified conceptual models usable for field-scale simulations of multi-phase production methods.

However a critical intermediate step remains that of validating the geometry of the geological fault/fracture network and characterizing it in terms of flow properties. This characterization step is usually performed by calibrating available field data, *e.g.* well tests, with simulated data. A 3D Discrete Fracture Network (DFN) simulator has been developed, enabling one to simulate single-phase flow in DFN models and to compute equivalent fracture flow properties. A genetic algorithm has been developed and coupled with the 3D DFN flow simulator in order to perform the simultaneous calibration of well tests data. Thus fracture properties are characterized such that their flow properties are consistent with the well tests data.

As a first step, the well tests data considered for calibration result from interpreted well tests *i.e.* equivalent transmissivities $K \cdot h$, with K the equivalent permeability that takes into account fracture flow properties, and h the reservoir thickness over which the well test has been interpreted. The genetic algorithm is described and applications are presented on a geologically-realistic fractured reservoir model having three facies, up to three fracture sets and seven wells. The characterized fracture properties are the mean length, mean conductivity, orientation dispersion factors, and facies-dependent properties such as the average spacing and the bed-crossing probability. The effectiveness of the genetic algorithm to characterize physically meaningful and data-consistent fracture properties is discussed.

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