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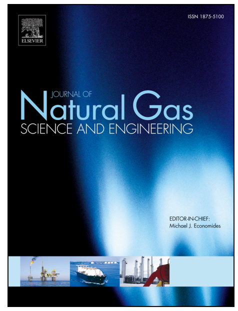

Application of multi-segment well approach: Dynamic modeling of hydraulic fractures

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Application of Multi-Segment Well Approach: Dynamic Modeling of Hydraulic Fractures

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Highlights

- Dynamic simulation of fracture changing along simulation time is challenge, and can be benefit from multi-segment well approach.
- This study demonstrated the flexibility and accuracy of using multisegment well approach against the traditional methods.
- A shale oil field case from midland basin is presented to show the accuracy of using multi-segment well approach.

Graphical Abstract – optional

Abstract

Hydraulic fracturing is a stimulation treatment routinely performed to create fracture network on low permeability reservoirs to enhance the productivity. Such induced fracture network has much higher conductivity and generally is treated through either local grid refinement (LGR) to capture the transient phenomenon or embedded discrete fracture model (EDFM). Both approaches require complex gridding meshes, leading to heavy computational time. LGR also requires the orthogonal orientation of hydraulic fracture with horizontal wellbore trajectory. Another challenge for LGR and EDFM comes from the dynamic meshing over the time. Infill drilling and re-fracturing are common due to the nature of the fast production decline in those hydraulically fractured wells. In the case of infill drilling or re-fracturing, the grids for the well or completion stages have to be generated from the beginning of the simulation, causing computational inefficiency. Also, sensitivity evaluation of well landing point, spacing, and completion optimization needs easy preprocessing of model input and short simulation time.

In this paper, we overcome the above challenges through representing hydraulic fracture network with multisegment well (MSW) concept. Multisegment wells (MSW) offer an improved description of the wellbore physics over conventionally modeled wells and can be used in different situations like, horizontal or multilateral wells, wells with inflow control devices (ICDs), and significantly varying flow conditions along the wellbore. On the other hand, the conventional well model (CWM) represents a well as a single pipe (single fluid) a MSW discretizes the well trajectory into several segments. Each segment has its fluid conditions and solution variables, hence allowing for detailed modeling of changing conditions along the wellbore.

Since MSW node system is independent of reservoir grid system, fracture orientation can be at any angle freely with wellbore trajectory, which avoids the complex LGR or EDFM and reduces the number of grids. Meanwhile, MSW provides a flexibility of fracture geometry representation, enabling easy addition and alteration of fractures at any simulation time.

Our MSW approach has been validated by comparing with the LGR through several benchmarking studies of a tight reservoir. A field case was demonstrated for infill drilling among existing vertical wells and re-fracturing operations. While it is difficult to model infill drilling of a well with hydraulic fractures through another modeling approach, the MSW option makes it easy by just opening the