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Development of Embedded Discrete Multi-Fractures Model for Simulation of Fractured Reservoirs

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Accurate and efficient numerical simulation of fractured reservoirs is important and challenging. Conventional dual porosity and dual permeability(DP/DK) models are efficient but not accurate, especially when fracture-diagnostic tools make it easier to get the detail of the complex fracture networks. Discrete-fracture models(DFM) have been developed to use information of fracture networks, which is still limited for its computational inefficiency. Recently, Embedded Discrete Fracture Model (EDFM) became a promising study orientation to overcome such problems.

In this study, we improve the EDFM approach by embedding discrete multi-fractures instead of simple fracture pieces in the matrix domain. Multi-fractures here stand for parts divided from fracture network, each consisting of multiple fractures and their intersection. This model has a comparative advantage: the embedded fracture network can be divided into larger and more complex parts with arbitrary shapes and sizes when meshing grid. And each complex part can be considered as a whole.

The calculation of conductivity between NNCs (Non-neighboring Connections) is the core of EDFM. We expound that the key to calculate conductivity of NNC is to approximate a local pressure field. Thus a new calculation method based on a more reasonable local pressure distribution has been developed. This method is suitable for the multi-fractures model and more accurate than the one used in original EDFM especially when matrix grid is coarser.

We demonstrate the accuracy and efficiency of the new conductivity calculation method and the embedded discrete multi-fractures model by performing a series of case studies with CarstSim simulator and comparing the results with the original EDFM and fine-grid models. We also present two numerical case studies to demonstrate the applicability of our method in naturally fractured reservoirs.

References

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