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Fracture matrix pore network model (FM-PNM): an efficient pore scale modelling method of fluid flow in fractured porous media

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Fluid flow in fractured porous media is concerned with various processes in science and engineering, including transport, chemical and mechanical processes, etc. Direct numerical simulations of fluid flow can investigate pore-scale processes and flow mechanisms in fractured permeable media. However, the tremendous computational costs prevent these methods from being applied to larger-scale models. On the contrary, pore network modelling is efficient and applicable to simulate large-scale porous media and handle thousands or even millions of pores simultaneously (Blunt, 2017). But currently, the pore network method can only be used in porous media without fractures.

In this work, we propose a new model to explicitly incorporate fractures into pore networks to represent fractured porous media. A new fracture matrix pore network model (FM-PNM) is developed to efficiently simulate the fluid flow properties in fractures associated with the pore matrix. The fractures are simplified as ideal planar cuboids with properties of aperture, width, length and orientation, which are then transformed into fracture pipe networks. The pore matrix is represented by a topological network of pore bodies (nodes) connected by pore throats (bonds). These two networks are coupled together to create a single nested network which is topologically equivalent to the fractured porous medium. The permeability of the coupled network (FM-PNM) is benchmarked by Lattice Boltzmann simulation for various structures of pore matrix and discrete fracture networks (Latt et al., 2020). A reasonable agreement was achieved which demonstrates the value and efficiency of the fracture matrix pore network model.

Participation

In-Person

References

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