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DFM-MINC Proximity Function for Unconventional Fractured Reservoirs Modeling

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Unconventional reservoirs are naturally fractured while presenting an extremely tight rock with low reservoir permeability. In order to have an economic development, a multistage hydraulic fracturing is needed. Due to this reservoir stimulation process, a complex fracture network is created between the well and the stimulated reservoir region leading to an increase in the exchange surface area between the matrix and the flowing fractures. Hence, flow modeling from such complex fractures network becomes tremendously challenging. In addition, existing modeling approaches based on the dual-continuum models (dual-porosity/dual-permeability) suffer from over-simplified or excessive assumptions where such models are unable to capture the transient fluid transfer between the matrix and the fracture. Note that, due to the low permeability in the matrix domain; the inter-porosity flow dominates. As a result, subdividing the matrix media using the MINC method is needed to accurately capture the transient flow. This work presents a Discrete Fracture Model (DFM) based on a Multiple Interacting Continua (MINC) proximity function; aiming to solve some of the problems mentioned above in fractured reservoir simulation. This hybrid hierarchical approach consists in a conductivity threshold leading to a triple-continuum model representation, consisting of: (1) the matrix media, (2) a high conductivity stimulated fracture network and (3) a low conductivity fracture network. Also, our proposed DFM is meshless where a 3D reservoir problem is reduced to a 1D flow problem. As well as, it offers the user the ability to fix the matrix refinement level which is a function of the fractures density and flow regime. One of the originalities of this approach relies on the way we use the well-known MINC formalism to subdivide the matrix grid-block. In order to validate the improvements from the proposed approach, several examples provide DFM-MINC proximity function accuracy validation, robustness and ability to conform complex fractures network while offering a superior computational efficiency, giving the user a rapid response for any sensitivity test.

Biography:

Nicolas Farah after completing his B.E. at Polytech' Marseille, Nicolas Farah went on to obtain a M.Sc. in Petroleum Engineering; specialized in Reservoir followed by a Ph.D. in geosciences, natural resources and environment from the University of Sorbonne's, Université Pierre et Marie Curie (UPMC). In addition, Nicolas Farah finished his Ph.D. at IFP Energies nouvelles (French Institute of Petroleum Engineering) at Rueil-Malmaison (France).

By September 2017, he was assigned as Assistant Professor of Petroleum Engineering in the School of Engineering at the Lebanese American University, Lebanon. Continuing from his doctorate research on flow modelling from unconventional reservoirs, the areas of research that interest him now include reservoir simulation and enhanced oil recovery methods.