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A midsurface extraction framework applied to core sample images for dimension reduction of fracture objects

Tuesday, 1 June 2021 20:00 (1 hour)

The modelling of multiphase flow and mechanical response in fractured chalk formations due to oil and gas explotation is of major importance in the understanding of the subsurface processes and the environmental impact associated with such activities. In addition, this knowledge is highly essential to predict unwanted effects from future carbon capture and storage (CCS) practices [1-3] and geothermal applications [4-6]. On the modelling of the fractures in porous media there are basically two classes of methods: (a) continuum methods [7-9] (or implicit methods), in which fractures and porous matrix are represented by two overlapping continua and a transfer function is used to model the interaction between these two, and (b) discrete methods [10–13] (or explicit methods), in which two different grids are used for fractures and porous matrix and the interplay between these two is represented explicitly. Employing a discrete method allows a more accurate representation of the fractures and subsequently the interplay between these and the porous matrix, but at the expense of a larger computational cost. The continuum approach presents a much lower computational cost. However, the existence of a representative elementary volume (REV) and accurate homogeneous parameters cannot be guaranteed [14]. Furthermore, previous works have shown that averaging the heterogeneous aperture to scale up permeability results in an underestimated fluid flow pattern [15], indicating the necessity of incorporating full aperture distributions rather than simplified aperture representations in reservoir-scale flow models [16–18]. Given the importance of the fractures modelling for accurate predictions of the fluid flow patterns and the extra cost involved in employing a discrete method, mixed-dimensional models [10,12,19], in which porous matrix is modelled as a d-dimensional entity, whereas fractures are modelled as $(d-1)$-dimensional entities, were developed aiming a cheaper but accurate framework. This work explores the reduction of two-dimensional fracture objects obtained from images to one-dimensional objects, such that a mixed-dimensional model might be employed. A skeletonization technique [20] along with a skeleton network generation [21] are employed for extraction of the one-dimensional fracture object, while medial axis [22] is used for aperture distribution calculation. The mesh generated through this framework is used in numerical simulations carried with the mixed-dimensional model for fluid flow in fractured porous media.

Time Block Preference

Time Block C (18:00-21:00 CET)

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Primary author: SOARES FERREIRA, Carlos Augusto (Danish Hydrocarbon Research and Technology Centre)

Co-author: Dr M. NICK, Hamid (DTU)

Presenter: SOARES FERREIRA, Carlos Augusto (Danish Hydrocarbon Research and Technology Centre)

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