Contribution ID: **429** Type: **Oral Presentation**

Image-based reconstruction of multiscale porous structures and coarsening of microporosity regions

Monday, 30 May 2022 17:50 (15 minutes)

A number of geological and industrial materials present multiscale porous structures, such as Estaillades limestones, tight sandstones, and catalyst layers of some electrochemical devices（Gao et al., 2019; Mehmani and Balhoff, 2015; Bultreys et al., 2016）. In the context of a digital rock of multiscale porous structures, we may resolve macropores by the μCT imaging technique, while unresolved regions will be termed as microporosity. Flow and transport in the macropores can be solved by either a pore-network model or a direct numerical simulation model. A Darcy-scale model is used for the microporosity. Furthermore, material properties in the microporosity may be obtained by the FIB-SEM technique. This sort of multiscale numerical framework has been seen in the literature(Guo et al., 2018;Zhang et al., 2021). However, computational efforts pertaining to the Darcy-scale modeling could be prohibitive, when tens of millions of voxels of microporosity are present in a digital rock. In this work, we propose a convolution-based method to conduct multilevel coarsening of microporosity, while keeping high-resolution domain interfaces between macropores and microporosity. We have developed our in-house code, and set up test cases of compressible single-phase flow in a digital rock of multiscale porous structures. The macropores are solved by the pore-network model, and the microporosity is solved by the single-phase Darcy model（Qin et al., 2021）. We will show that alongside the developed coarsening technique, our hybrid model is pretty robust, which not only considerably reduce computational efforts, but also well predict multiscale flow and transport phenomena.

Acceptance of the Terms & Conditions

Click here to agree

MDPI Energies Student Poster Award

Yes, I would like to submit this presentation into the student poster award.

Country

china

References

[1] Y. Gao, A. Qaseminejad Raeini, M.J. Blunt, B. Bijeljic.(2019). Pore occupancy, relative permeability and flow intermittency measurements using X-ray micro-tomography in a complex carbonate. Adv. Water Resour., 129, 56-69.
[2] Y. Mehmani, M.T. Balhoff. (2015). Mesoscale and hybrid models of fluid flow and solute transport. Rev. Mineral. Geochem., 80 (1), 433-459,
[3] Bultreys, T., Stappen, J.V., Kock, T.D., Boever, W.D., Boone,M.A., Hoorebeke, L.V., Cnudde, V.(2016). Investigating the relativepermeability behavior of microporosity-rich carbonates and tightsandstones with multiscale pore network models. J. Geophys. Res.Solid Earth121,(11), 7929–7945 .

[4] Guo, B., Ma, L., & Tchelepi, H. A.(2018). Image-based Micro-continuum Model for Gas Flow in Organic-rich Shale Rock. Adv Water Resour, 122, 70-84.
[5] Zhang et al. (2021). An image-based hybrid pore network-continuum modeling framework for fluid flow in porous media. AGU Fall Meeting.
[6] Qin C.-Z., van Brummelen H., Hefny, M., & Zhao J. (2021). Image-based modeling of spontaneous imbibition in porous media by a dynamic pore network model. Adv. Water Resour., 152, 103932.

Time Block Preference

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

Participation

Unsure

Primary authors: Mr SHI, bowen (Chongqing university); Ms JIANG, Han (Chongqing University); Ms ZHANG, li (Chongqing University); Prof. GUO, Bo (University of Arizona); Dr QIN, Chao-Zhong (Chongqing University)

Presenter: Mr SHI, bowen (Chongqing university)

Session Classification: MS09

Track Classification: (MS09) Pore-scale modelling