Contribution ID: **303** Type: **Oral Presentation**

Variation of the representative elementary volume (REV) in heterogeneous rocks with changing CT image resolution

Thursday, 2 June 2022 09:10 (15 minutes)

The two paradigms of digital rock physics, chemistry, and biology are imaging and computation (Sadeghnejad et al. 2021). An unbiased characterization of rocks not only requires a sample with a sufficient volume (i.e., representative elementary volume, REV) to account for sample heterogeneity but also requires a high-resolution image with enough pore-scale details (Lin et al. 2019, Jackson et al. 2020). However, imaging at the highest resolution is expensive; therefore, there should be an optimum resolution wherein the accuracy of the pore-scale studies can be guaranteed.

REV can be computed both deterministically or statistically. Deterministic REVs can be computed by finding a field-of-view (FOV) in which the property of interest (e.g., porosity, permeability, tortuosity) no further fluctuates. However, a statistical REV is defined as the representative volume below which the statistics (e.g., mean, standard deviation, coefficient of variation) for a quantity of interest vary with the scale. Different properties may have different REVs. Moreover, from one porous medium to another or depending on the overall dimensions of the problem, the REV size will typically vary among different scale ranges (Hommel et al. 2018).

Berea sandstone samples of 10 –15 mm length and 4 mm diameter were drilled from one sample block. The samples were scanned in various resolutions by utilizing X-ray microtomography (μXCT) and an X-ray synchrotron light source. The grey value images were segmented by applying a random forest classifier. Rock properties (including porosity, permeability, tortuosity, Minkowski measures) were computed on FOVs of varying size by applying the commercial GeoDict software package (Math2Market, Kaiserslautern, Germany) and coding in Python. In this study we aim to analyse whether REVs for properties with high computational costs (i.e., permeability) might be replaced with REVs of other properties (e.g., surface area, Minkowski measures), which have lower computational demands. Furthermore, an analysis of deterministic and statistical REVs revealed different REV sizes for the computed parameters and a dependence of REV size on the spatial resolution.

Acknowledgement
The second author (S.S.) gratefully acknowledges financial support from the Alexander von Humboldt Foundation for his visiting research at the Johannes Gutenberg University at Mainz, Germany.

Acceptance of the Terms & Conditions

Click here to agree

MDPI Energies Student Poster Award

No, do not submit my presenation for the student posters award.

Country

Germany

References

Hommel, J., E. Coltman and H. Class (2018). "Porosity–permeability relations for evolving pore space: a review with a focus on (bio-) geochemically altered porous media." Transport in Porous Media 124(2): 589-629.
Jackson, S., Q. Lin and S. Krevor (2020). "Representative Elementary Volumes, Hysteresis, and Heterogeneity in Multiphase Flow From the Pore to Continuum Scale." Water Resources Research 56(6): e2019WR026396.
Lin, W., X. Li, Z. Yang, M. Manga, X. Fu, S. Xiong, A. Gong, G. Chen, H. Li and L. Pei (2019). "Multiscale digital porous rock reconstruction using template matching." Water Resources Research 55(8): 6911-6922.
Sadeghnejad, S., F. Enzmann and M. Kersten (2021). "Digital rock physics, chemistry, and biology: challenges and prospects of pore-scale modelling approaches." Applied Geochemistry: 105028.

Time Block Preference

Time Block A (09:00-12:00 CET)

Participation

Online

Primary authors: REINHARDT, Marcel; SADEGHNEJAD, Saeid (Department of Petroleum Engineering, Faculty of Chemical Engineering, Tarbiat Modares University, Tehran, Iran); ENZMANN, Frieder; KERSTEN, Michael (Johannes Gutenberg-University Mainz, Germany)

Presenter: REINHARDT, Marcel

Session Classification: MS09

Track Classification: (MS09) Pore-scale modelling