Contribution ID: **354** Type: **Poster (+) Presentation**

Adaptive phase recovery method for three-dimensional porous media reconstruction from its bi-dimensional thin-section

Thursday, 3 June 2021 14:40 (1 hour)

Determining the macroscopic properties of heterogeneous materials requires detailed knowledge of their porous structure. The most widely used experimental methods allow obtaining high-quality bi-dimensional images of porous media samples. At the same time, direct investigation of three-dimensional samples is a technologically complicated process and requires expensive laboratory equipment. Different approaches as simulated annealing [1, 2], truncated Gaussian random fields [3], multi-point statistics [4] are applied for the solution of this problem. These methods have such disadvantages as significant computing requirements and simplified representation of porous media. Authors [5] present a method for reconstruction of multiphase structure from two orthogonal thin sections based on the phase recovery algorithm. This method is conveys microstructure morphology of porous media but its performance leads to artifacts that can influence the macroscopic properties of a reconstructed sample.

The artifacts influence the permeability of the reconstructed sample because of the additional solid phase inside the pore space. To solve this problem, we offer another phase-recovery-based method. The main idea of the method is to approximate three-dimensional autoconvolution by the rotation of an input image bidimensional autoconvolution. We use adaptive spatial frequency filtering and dynamic correction in Fourier space to remove artifacts and improve the quality of reconstruction.

The resulting method is highly efficient and allows us to obtain detailed reconstructions. We reconstruct samples of carbonate, sandstone, and ceramics from the thin-sections of microCT images (as it is shown in the figure) and compare permeabilities computed by finite differences method Stokes solver (FDMSS) [7] for originals and reconstructions. The reconstructed samples' capacity-volumetric properties show good compliance with the original samples.

Time Block Preference

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

References

1. Cule D., Torquato S. Generating random media from limited microstructural information via stochastic optimization //Journal of applied physics. –1999. –V. 86. –№. 6. –P. 3428.
2. Ballani F., Stoyan D. Reconstruction of random heterogeneous media //Journal of microscopy. –2015. –V. 258. –№. 3. –P. 173.
3. Hyman J. D., Winter C. L. Stochastic generation of explicit pore structures by thresholding Gaussian random fields //Journal of Computational Physics. –2014. –V. 277. –P. 16.
4. Hajizadeh A., Safekordi A., Farhadpour F. A. A multiple-point statistics algorithm for 3D pore space reconstruction from 2D images //Advances in water Resources. –2011. –V. 34. –№. 10. –P. 1256.
5. Hasanabadi A. et al. Efficient three-phase reconstruction of heterogeneous material from 2D cross-sections via phase-recovery algorithm //Journal of microscopy. –2016. –V. 264. –№. 3. –P. 384.

6. Fullwood D. T. et al. Microstructure sensitive design for performance optimization //Progress in Materials Science. –2010. –V. 55. –№. 6. –P. 477.
7. Gerke, Kirill M., et al. "Finite-difference method Stokes solver (FDMSS) for 3D pore geometries: Software development, validation and case studies." Computers & geosciences 114 (2018): 41-58.

Acceptance of Terms and Conditions

Click here to agree

Newsletter

Student Poster Award

Primary authors: Mr CHERKASOV, Aleksei (MIPT); Mr ANANEV, Andrey (MIPT); Mr KHLYUPIN, Aleksey (MIPT); Mr GERKE, Kirill

Presenter: Mr CHERKASOV, Aleksei (MIPT)

Session Classification: Poster +

Track Classification: (MS10) Advances in imaging porous media: techniques, software and case studies