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1 Enhancing pore network extraction performance via seed-based pore region growing segmentation

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- a PREGO algorithmPore network extractionPorous materialsTransport propertiesPore network modelling
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2 Highlights

- Developed Pore Region Growing (PREGO) algorithm, a novel solution to address segmentation challenges in large-sized 3D images used for pore network modeling.
- The PREGO algorithm accurately predicted diffusive behavior and viscous fluid flow within the pore phase network, demonstrating excellent agreement with lattice Boltzmann simulations and experimental data.
- Notable enhancement in computational efficiency of the PREGO algorithm over traditional methods, reducing memory consumption by 50
- Structural analysis revealed it captures pore and throat sizes in close agreement with existing approaches.

3 Abstract

Pore-scale modeling, aided by imaging advancements and computational power, is now a vital tool for comprehending fluid flow and transport in porous media. It allows detailed exploration of pore structures and analysis of fluid dynamics and mass transport at smallest scales. This work

presents the Pore Region Growing (PREGO) Algorithm, a novel approach to address segmentation challenges encountered in large-sized 3D images used for pore network modeling. The algorithm overcomes limitations of traditional methods like the watershed algorithm, in both computational time and memory of the pore segmentation. Like the watershed method, the proposed work involves identifying seed points, then grows each to fill their respective basis. The algorithm differs from existing approaches in that it efficiently prioritizes and grows the seed points using a FIFO queue, resulting in well-defined segmentation with clear and smooth boundaries between neighboring regions. The output was validated by demonstrating the algorithm's robustness in predicting diffusive behavior and viscous fluid flow within the pore phase network, with excellent agreement in comparison to lattice Boltzmann simulations and experimental data. The proposed algorithm was also shown to accurately predict transport properties under varying porosity, and different types of real porous media images. The evaluation of the Intersection over Union (IoU) and Dice Similarity Coefficient (DSC) metrics revealed that the PREGO technique had a maximum error of 5.44

4 Keywords

PREGO algorithm;Pore network extraction;Porous materials;Transport properties;Pore network modelling