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Porous Structure Reconstruction Using Convolutional Neural Networks

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A three-dimensional (3D) high resolution inner structure of rock sample is premise for pore-scale flow simulation of reservoir. μ-CT is considered to be the most direct way to obtain the 3D inner structure of porous media without deconstruction. However, its micrometer resolution limits its application in characterization of small structures such as nano-pores and channels which are critical for fluid transportation. An effective strategy to solve this problem is applying numerical reconstruction methods to improve the resolution of porous structure extracted from μ-CT image. In this paper, we introduce a convolutional-neural-networks reconstruction (CNNR) method to reconstruct high resolution porous structure based on low resolution tomographic μ-CT image and high resolution SEM image(s). The proposed method is carried out through four steps. Firstly, a rock sample is scanned by μ-CT to build a relative low resolution 3D tomographic image. Then one or more sections in the rock sample are selected to be scanned by SEM to obtain the high resolution 2D images. After that, the high resolution segmented SEM images and their corresponding low resolution μ-CT slices are used to train the CNN model. Finally, the trained CNN model is used to reconstruct the whole low resolution 3D μ-CT image. Due to the SEM images are segmented and have higher resolution than that of μ-CT image, this algorithm integrates the super resolution and segmentation process together. The input data is low resolution tomographic μ-CT image and the output is high resolution segmented porous structure. The experimental result shows that the proposed method is able to achieve the state-of-the-art performance.

References

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