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Development of Deep Learning Based Method for Pore Identification of Core CT Images

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Deep learning (DL) methods are widely used to recognize objects in images. This paper presents a step-by-step workflow to develop a DL-based model for identifying the pores of CT images of core plugs. In this work, some CT images of core plugs are segmented into binary images using threshold method, after post-processing the binary images acting as labels of the original images. The CT images and corresponding labels are fed to a program to generate image-label pairs for building training dataset. A 13-layer semantic segmentation network with 4 convolutional layers is constructed based on deep learning algorithm, and the network is trained with the built training datasets of three different resolutions, respectively. The trained models are tested with different images.

The training results show that the effect of image resolution is obvious and training the network with high-resolution images shows higher accuracy and lower loss. All global accuracy and mean accuracy of different resolution training images are above 0.88. The global accuracy of training network with high-resolution image of low permeability core plug reaches 0.94. The trained network is tested with different images, including images from the same core, images with resolution similar to training images, and low-resolution images. The test results show that the network trained with images whose resolution can capture pores well shows better performance, and the predictive performance of the network trained using low-resolution images is unstable. Compared with the threshold method, the binary image generated by the semantic segmentation method has less noise, thus reducing the post-processing operations of the binary image. Applying the model to batch images with similar grayscale and similar resolution is more efficient than threshold method.

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