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Microscopic flow parameters prediction of shale oil based on deep learning

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Abstract:Shale oil is a valuable unconventional oil and gas resource. It has a complex mineral composition, and rapid and accurate prediction of core flow parameters is crucial for its exploration and development strategy. At present, researchers predict flow parameters such as speed,pressure,apparent permeability,etc. through core experiments that require specific experimental conditions and methods, which are difficult and time-consuming. Conventional simulation methods for predicting flow parameters require considerable computational resources. Therefore, deep learning can be used as a pore-scale simulation prediction method. Considering that the mineral properties of the nanopore wall of shale oil have a large influence on the flow, a core dataset with organic distribution.

We predict the flow parameters of shale oil porous media by two methods. First,we designed a convolutional network for the dataset, adopted the structure of SE-ResNet, added the squeeze-and-excitation (SE) module to the double-layer residual module of ResNet18, and combined the characteristics of the SE block with the attention mechanism and ResNet to effectively obtain the information between channels and avoid the problem of gradient disappearance or explosion. Using SE-ResNet for directly predicting the apparent permeability from images. Another method attempts to couple a point cloud residual network with flow equations, reconstruct the flow field and predict apparent permeability. The coordinates of the porous media pore space are used as input to the point cloud network. Different slip conditions are set for organic and inorganic matter. The loss function of the neural network is constructed by the NS equation, the continuity equation, and the flow boundary between organic matter and inorganic matter.Based on the principle of PINN, optimization algorithms such as gradient descent are used to obtain the weight parameters of neural network connection and the physical parameters of partial differential equations. Only sparse data acquisition points are required to predict microscopic flow parameters. The above two methods are well applied in shale porous media.

Participation

In-Person

References

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