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OPTIMUM SEGMENTATION OF A SANDSTONE RESERVOIR MICRO-CT IMAGERY USING MACHINE LEARNING ALGORITHMS

Thursday, 3 June 2021 20:00 (1 hour)

Image analysis of micro-CT (computed tomography) images, which can provide nondestructive evaluation of rock properties (porosity, permeability, etc.), is largely dependent upon optimum segmentation of the image objects. Traditionally, images are segmented using pixel threshold values derived from statistical analysis (e.g., Otsu thresholding method). However, the statistical threshold segmentation algorithms have several constraints that can limit their application: 1) statistical methods return different thresholds that do not converge on a single ground truth; 2) it is difficult to categorize boundary areas where the pixels could belong to several adjacent objects; 3) the contextual relationships of the image objects cannot be included; and 4) domain knowledge of the petrology is required. In this study, we show that supervised machine learning assisted segmentation algorithms can be leveraged to address these issues. In this study, various machine learning algorithms were used to segment the micro-CT images scanned from conventional sandstone reservoir core samples. For supervised machine learning, the labeled images were manually annotated (grain matrix and pores). A traditional machine learning algorithm (random forest classification) and a deep learning algorithm (u-net convolutional neural network) were used in tandem. For the random forest classification algorithm, the feature data set was created by applying various filters to the pixel matrix, such as an image texture capture filter (Gabor filter), edge detection filters (Canny, Roberts, Sobel, Scharr, Prewitt), and noise removal filters (Gaussian blurring, median filters). The u-net convolutional neural network is a deep learning algorithm, and it is trained on augmented images to reduce the labor of image annotation. Finally, the performance of the three types of segmentations, i.e., Otsu thresholding, random forest classification and u-net were compared. An optimized segmentation process with higher accuracy and faster speed is essential for further evaluation of pore sizes and 3D microstructures within the sandstone samples at various scales.

Time Block Preference

Time Block C (18:00-21:00 CET)

References

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