Image Segmentation with Transfer Learning for Carbonate Rock Images

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Abstract— The approach of using machine learning related or deep neural networks for semantic segmentation has highly been successful in various areas of research irrespective of the levels of complexity of the structural patterns involved in images of interest. With the adoption of unsupervised learning, human related errors in segmentation may be suppressed and process time saved. However, it should be noted that machine or deep learning related approaches demand for large datasets for training and high computational resources due to the huge numbers of training parameters and image samples.

In this study, we explore the implementation of transfer learning, using pretrained networks VGG16 [1] and MobileNet-V2, into end-to-end semantic segmentation architectures proposed in the literature, i.e. SegNet [2] and UNet [3], respectively. We implement this study on highly heterogenous real rock 2D carbonate images from our laboratory, to evaluate a number of evaluation metrics including precision and recall and compare to verify the effectiveness of the binary cross-entropy and dice loss functions on image semantic segmentation. We also evaluate and compare the porosity prediction results using segmented images from the proposed models as a measure of evaluating the influence of transfer learning on deep learning-based image segmentation.

Results show that the state-of-art transfer learning, responsible for the transfer of learned weights into a new training environment is able reduce model training computation time and the number of rock image samples required for training. We are also able to achieve the intended training performance, relatively comparable to that obtained from the originally proposed networks, i.e., SegNet [2] and UNet [3] with limited number of training samples. Our results show comparable rock porosity predictions between the ground truth, original and proposed model predictions.

References

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