Using Image Analysis to Estimate Unconventional Rock Properties

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Abstract

The oil and gas industry is seeing a large increase in various image acquisition modalities for the purpose of analysis core material. This includes modalities such as micro-CT, SEM, FIB-SEM, to name a few. Processing these images to extract meaningful statistical information is proving a challenge for standard commercial software as these images fall either into the category of been too large “order of multi-Gigabyte” or the algorithms required to process them are too computationally expensive, such as image registration and the non-local means filter. Discussed will be the full GPU based image processing work-flow implemented in house at shell designed for the ability to process the images in a short amount of time. Some applications discussed will include overcoming the FIB-SEM stack alignment problem, filtering and segmentation. We also studied the effects of several different filtering algorithms, and segmentation routines on the final segmentation and how these subsequently affect porosity and total organic carbon content.

As part of the study an integrated approach to sample analysis has been developed that links microCT volumes, transmitted and reflected light imaging, and SEM observation at a range of magnifications. Mosaic images of the entire plug end trim are obtained by taking several thousand images and stitching them together and this was done for the thin section and the SEM images. These mosaic images are used to document the various types of lamina that make up the sample, and the volume percentage of the sample that is comprised of each lamina type. SEM image mosaics are constructed within each lamina type at various magnifications, and under a suite of accelerating voltage conditions, in both secondary electron (SE) and backscattered electron (BSE) modes. Image processing and image acquisition work flows are built around these various imaging modalities.