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Multi-Step Segmentation Protocol for Digital Rock Systems

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A key element in digital rock physics is the segmentation of μ-CT scanned grayscale images into their constituent components, i.e. rock and pore. In this work, a multistep approach of segmentation is presented where the high degree of correlation present in neighboring voxels is utilized. The first step in the workflow is a modified fuzzy c-means algorithm which incorporates spatial information in the membership function during the clustering process [1]. This process segments the image into regions corresponding to the rock phase, the pore phase and the unsegmented phase based on the degree of membership. This information is then used as a priori knowledge to complete the segmentation using a method inspired by indicator kriging [2]. This method is advantageous as it reduces spurious blobs and is less sensitive to noise as compared to conventional segmentation algorithms such as Otsu and watershed. These segmented images are then used in simulators to obtain petrophysical properties such as porosity, permeability and capillary pressure curves which are validated against experimental values.

References

[1] Chuang, Keh-Shih, et al. "Fuzzy c-means clustering with spatial information for image segmentation." computerized medical imaging and graphics 30.1 (2006): 9-15.

[2] Oh, Wonho, and Brent Lindquist. "Image thresholding by indicator kriging." IEEE Transactions on Pattern Analysis and Machine Intelligence 21.7 (1999): 590-602.

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