World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:14, No:12, 2020

Multiscale Simulation of Absolute Permeability in Carbonate Samples Using 3D X-Ray Micro Computed Tomography Images Textures

Authors : M. S. Jouini, A. Al-Sumaiti, M. Tembely, K. Rahimov

Abstract : Characterizing rock properties of carbonate reservoirs is highly challenging because of rock heterogeneities revealed at several length scales. In the last two decades, the Digital Rock Physics (DRP) approach was implemented successfully in sandstone rocks reservoirs in order to understand rock properties behaviour at the pore scale. This approach uses 3D X-ray Microtomography images to characterize pore network and also simulate rock properties from these images. Even though, DRP is able to predict realistic rock properties results in sandstone reservoirs it is still suffering from a lack of clear workflow in carbonate rocks. The main challenge is the integration of properties simulated at different scales in order to obtain the effective rock property of core plugs. In this paper, we propose several approaches to characterize absolute permeability in some carbonate core plugs samples using multi-scale numerical simulation workflow. In this study, we propose a procedure to simulate porosity and absolute permeability of a carbonate rock sample using textures of Micro-Computed Tomography images. First, we discretize X-Ray Micro-CT image into a regular grid. Then, we use a textural parametric model to classify each cell of the grid using supervised classification. The main parameters are first and second order statistics such as mean, variance, range and autocorrelations computed from sub-bands obtained after wavelet decomposition. Furthermore, we fill permeability property in each cell using two strategies based on numerical simulation values obtained locally on subsets. Finally, we simulate numerically the effective permeability using Darcy's law simulator. Results obtained for studied carbonate sample shows good agreement with the experimental property.

Keywords : multiscale modeling, permeability, texture, micro-tomography images
Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development
Conference Location : Chicago, United States
Conference Dates : December 12-13, 2020