Geophysical Research Abstracts
Vol. 14, EGU2012-967, 2012
EGU General Assembly 2012

Sequential and gravitational algorithms for soil and other porous media modeling

R. Vasilyev (1), K. Gerke (2), M. Karsanina (2), and D. Korost (3)

(1) Vladimir State University, Department of Applied Mathematics and Physics, (2) Institute of Geospheres Dynamics of Russian Academy of Science, Laboratory of Geomechanics and Fluidodynamics, (3) Moscow State University, Geology Department

There are three main approaches to model and reconstruct (using 2D cut(s), grain size distribution or some other limited information/properties) porous media: 1) statistical methods (correlation functions and simulated annealing, multi-point statistics, entropy methods), 2) sequential methods (sphere or other granular packs), and 3) morphological methods. Each method has both its own strong sides and disadvantages. In this contribution we mainly focus on sequential method due to its simplicity for different transformation modeling: diagenesis, mechanical compaction, erosion, etc. It is well known that process-based models for sandstone thin-sections give good transport properties after 3D reconstruction. This method is also useful in pore-network extraction validation. However, sequential algorithms are usually work properly only for quite homogeneous structures without cracks and fissures and, thus, are not appropriate for most soils.

Based on limited data (2D cut(s), porosity, grain size distribution, etc.) soil and sandstone structure are modeled using different sequential and novel gravitational algorithms. Quality of reconstruction is validated using conventional analysis based on local porosity theory, against original 3D structures obtained using X-ray microtomography and via comparison of experimental and numerically obtained transport properties. Process-based type sequential algorithms gave good results for most sandstones, but for soils reconstructions were not satisfactory. For that reason separate pore volumes were introduced into the model using the similar sedimentation mechanism as for solid grains. In this case results for complex porous media were greatly improved.

Gravitational algorithm was found to be especially useful for soil aggregate modeling. In future this method can be greatly improved using different forces for various soil components (e.g., different minerals, organic matter, etc.). We also compare different methods against experimental polydisperse spheres packs. A discussion on possible developments for numerous practical implementations like erosion, pressure and geochemical alterations is given. A possible hybridization using other statistical or morphological porous media modeling methods can be a valuable upgrade in future.