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Influence of non-stationarity within porous media sample on its flow properties

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The structure of the sample defines its physical properties. The homogenization based on different fields (e.g., pressure and velocity for permeability property) produces general property of the sample. For this property to be useful for continuum-scale modelling it has to be representative for the volume it will be substituted for in the next level model. This explains the importance of conventional REV concept. To be a REV, the structure has to be statistically homogeneous [1], but this is not necessarily achieved in real porous media samples such as rocks and soils [2]. This is where pore-scale modelling gets really handy –we can still perform homogenization and substitute the averaged property. In this contribution we discuss the influence of spatial non-stationarity on flow properties using full permeability tensor [3,4] as an example. To establish interrelationships, we create artificial porous media structures with different degrees of non-stationarity using stochastic reconstruction methodology [5,6].

In this presentation we shall focus on:

- Methodology to produce porous media structures with different degree of anisotropy;
- Tensorial property assessment for such structures;
- Applications for real homogenization and upscaling cases.

The degree of stationarity of the stochastic reconstructions had a significant influence on the physical properties of the reconstructed binary structures—computed full permeability tensors showed different degree of anisotropy and off-diagonal terms values. The proposed approach to produce nonstationary structures from ensemble averaged set of correlation functions opens numerous ways to attack theoretical and practical problems with natural and artificial porous materials with statistically inhomogeneous structure. Moreover, it is possible to produce large scale inhomogeneous porous structures to parameterize, test and verify different upscaling schemes starting from pore-scale.

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