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Tensorial flow properties for rocks and soils: from pore-scale computations to continuum-scale applications

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In order to parameterize flow and transport continuum-scale models a detailed information on flow properties of modelled rocks and soils is needed. The most critical physical property in this regard is permeability which is usually obtained from core measurements. Such measurements are quasi-1D as pressure gradient is applied in the single direction along the major axis of the cylindrical core. While it is possible to perform multi-directional measurements on full-size consolidated rock cores and/or cubical unconsolidated soils, these approaches apply unrealistic no-flow boundary conditions [1]. The problem of experimental measurements can be circumvented using pore-scale modelling techniques [2,3]. The 3D structural information on rock/soil structure can be obtained using XCT imaging, stochastic reconstructions [4,5] or multiscale image fusion [6,7] based on the superposition of different methods. In this contribution we discuss all these important issues in detail and provide a pore-scale modelling solution on the basis of FDMSS free software package [3]. Our examples of its applications to rock and soil material [8] indicate the importance of off-diagonal permeability tensor terms and its potential influence on continuum-scale simulations using Richards/Darcy based modelling.

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