Nonlinear domain decomposition for the Richards equation in heterogeneous soil

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We present a new numerical solution method for the Richards equation in heterogeneous porous media. Our approach is based on the Kirchhoff transformation which can be carried out in case of homogeneous soil. As a result convex minimization problems are obtained to which monotone multigrid methods can be applied. We assume that different homogeneous soils are located in different subdomains while the coupling condition imposes continuity of the pressure and the water flux across the interfaces between the subdomains. This heterogeneity is addressed via a non-overlapping domain decomposition method, more concretely a nonlinear Robin method providing for an iteration of the coupled homogenous problems. Gravity is discretized explicitly in time using an upwind technique given by a viscosity term within our finite element discretization. Both the free boundary of the seepage face around surface water coupled with the Richards equation and the free boundary separating the saturated from the unsaturated regime can be determined robustly by our solver.

In the talk we give a short presentation of our solution method and mention some analytical results. Furthermore, we present various numerical results which are intended to demonstrate the efficiency and robustness of the method for usual soil parameters and its applicability in practical situations.