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Nonlinear domain decomposition for saturated-unsaturated flow through heterogeneous porous media

We present a numerical solution technique for the Richards equation in heterogeneous soil without linearizing the problem. Our approach is based on Kirchhoff transformation which can be carried out in case of a homogeneous porous medium. 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 nonlinear nonoverlapping domain decomposition. More concretely, a Dirichlet–Neumann or, alternatively, a Robin method provides 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. Our solver determines both the free boundary separating the saturated from the unsaturated regime and the free boundary of the seepage face around surface water coupled with the Richards equation.

In the talk we give a presentation of our solution method and mention some analytical results in 1D. Furthermore, we present various numerical results in 2D which show the concrete behaviour of the domain decomposition methods in different situations and demonstrate the applicability of our technique for usual soil parameters.

Joint work with:
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