Abstract

This work is concerned with the theoretical analysis of a discontinuous Galerkin method applied to Richards' equation, one of the governing equations of porous media flow modeling. In our analysis, we admit the fast diffusion type of degeneracy, which this nonlinear degenerate parabolic equation may exhibit. Given the nonlinearities, we choose a local discontinuous Galerkin method to discretize the spatial variable. Further, we consider the resulting semidiscrete scheme, where special attention is paid to the estimation of the accumulation term that can possibly vanish. Using the continuous mathematical induction approach, we derive a priori error estimates in the L^2-norm and the jump form with respect to the spatial discretization parameter and the Hölder coefficient of the accumulation term derivative. Moreover, we present numerical experiments supporting the theoretical results. In addition, we study an anisotropic higher-order space-time discontinuous Galerkin method applied to two formulation of Richards' equation, the hydraulic head-based and the pressure head-based formulations. Namely, we examine the computational performances of this method and give a comparison of both model problems on a practial application of porous media flow.