High-order numerical schemes for semi-linear advection reaction equations based on discontinuous Galerkin method and Rosenbrock-type methods

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Simulation of transport systems is challenging due to coupled processes in highly heterogeneous porous media. We propose a numerical method based on Discontinuous Galerkin (DG) method for spatial discretization coupled with the Rosenbrock-type methods for time discretization to simulate transport processes in highly heterogeneous porous media. The Discontinuous Galerkin method is well known to be high order in space, while the Rosenbrock-type methods are high order in time. This combination yields a highly accurate method to simulate transport processes in porous media. In contrast to stable implicit Euler methods usually used in the literature where nonlinear algebraic equations are solved at every time step, Rosenbrock-type methods are usually A-stable and only a few linear systems are solved at each time step. Numerical simulations in highly heterogeneous porous media are performed to prove the high order accuracy of the proposed numerical scheme.