Abstract

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Lie-group method for predicting water content for immiscible flow of two fluids in a porous medium

We apply Lie-group method for determining symmetry reductions to nonlinear diffusion-convection equation arising in modeling the immiscible flow of two fluids in a porous medium. This equation was presented by Fokas and Yortsos [1], for oil and water flow in petroleum-reservoir, which is given by x V t f x D t x ? ? ? ?? ? ?? ? ? ? ? ? = ? ? ( ) ( ) ( ) ? ? ? ? , where t is time, x is the space variable, ? is the normalized volumetric water content (0?? ?1), D(?) is the water diffusivity, f (?) is the fractional flow function and V(t) is the combined flow rate of both fluids which is a function of time only, since we assume incompressibility of both fluids. Lie-group method starts out with a general infinitesimal group of transformations under which a given partial differential equation is invariant, then, the determining equations are derived. The determining equations are a set of linear differential equations, the solution of which gives the transformation functions the infinitesimals of the dependent and independent variables. After the group has been established, a solution to the given partial differential equation may be found from the invariant surface condition such that its solution leads to similarity variables which reduce the number of independent variables in the given partial differential equation.