On Two-Phase Forchheimer Flows of Incompressible Fluids

Luan Hoang*, Akif Ibragimiov, and Thinh Kieu
Department of Mathematics and Statistics
Texas Tech University, U. S. A.
*luan.hoang@ttu.edu

Abstract

We model multi-dimensional two-phase flows of incompressible fluids in porous media using generalized Forchheimer equations and the capillary pressure. We find a family of steady state solutions whose saturation and pressure are radially symmetric and velocities are rotation-invariant. Their properties are investigated based on relations between the capillary pressure, each phase's relative permeability and Forchheimer polynomial. The linearized system at those steady states is derived and reduced to a parabolic equation for the saturation. This equation has a special structure depending on the steady states which we exploit to prove two new forms of the lemma of growth of Landis-type in both bounded and unbounded domains. Using these lemmas, qualitative properties of the solution of the linearized equation are studied in details. This is joint work with Thinh Kieu and Akif Ibragimov.