Texas Tech University. Analysis Seminars.

Models and analysis of fluid flows in heterogeneous porous media

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Monday, March 6, 2017
Room: MATH 010. Time: 4:00pm.

ABSTRACT. The most common equation to describe fluid flows in porous media is the Darcy law. However, this linear equation is not valid in many situations, particularly, when the Reynolds number is large or very small.

In the first part of this talk, we survey the Forchheimer models and their generalizations for compressible fluids in heterogeneous porous media. The Forchheimer coefficients in this case are functions of the spatial variables. We derive a parabolic equation for the pressure which is both singular/degenerate in the spatial variables, and degenerate in the pressure's gradient.

In the second part, we model different flow regimes, namely, pre-Darcy, Darcy and post-Darcy, which may be present in different portions of a porous medium. To study these complex flows, we use a single equation of motion to unify all three regimes. Several scenarios and models are then considered for slightly compressible fluids. A nonlinear parabolic equation for the pressure is derived, which is degenerate when the pressure's gradient is either small or large.

We estimate the pressure and its gradient for all time in terms of the initial and boundary data. We also obtain their particular bounds for large time which depend on the asymptotic behavior of the boundary data but not on the initial one. Moreover, the continuous dependence of the solutions on the initial and boundary data, and the structural stability for the equations are established.