Texas Tech University. Applied Mathematics Seminar.

Structural Stability of Generalized Forchheimer Flows of Any Degree

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ABSTRACT. We study the generalized Forchheimer equations for slightly compressible fluids in porous media with Dirichlet boundary data. The Forchheimer polynomial has arbitrarily large degree. We prove that the solution depends continuously on the coefficients of the Forchheimer polynomial in L^α-norm and $W^{1,2-a}$-norm for both finite time intervals and time infinity. Here, $\alpha \geq 1$ is arbitrary, and number $a \in (0,1)$ depends on the degree of the Forchheimer polynomial. The stability is established by using a perturbed monotonicity and the structure of the equation to treat the cross-terms $|\nabla p_1|^{2-a}|\bar{p}_2|^{\alpha-2}$ and $|\nabla p_2|^{2-a}|\bar{p}_1|^{\alpha-2}$ of individual solutions p_1 and p_2. New Poincaré-Sobolev inequalities and non-linear Gronwall-type estimates for non-linear differential inequalities are utilized to derive the asymptotic bounds for mixed terms. This is joint work with Luan Hoang, Akif Ibragimov and Zeev Sobol.