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One-phase flow in porous media: is the Forchheimer correction relevant ?

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Abstract:

Our interest in this work is dedicated to the dependence upon the filtration velocity (or Reynolds number) of the inertial correction to Darcy's law for one-phase flow in homogeneous porous media. The starting point of our analysis is the averaged flow model operating at Darcy's scale. It shows that the inertial correction to Darcy's law involves a second order tensor that can be determined from the solution of the associated closure problem requiring the microscopic (pore-scale) velocity field. Numerical solutions achieved on 2D model structures are presented. The accent is laid upon the role of the Reynolds number, pressure gradient orientation and structural parameters such as porosity and structural disorder. The Forchheimer type of correction, exhibiting a quadratic dependence upon the filtration velocity, is discussed in different situations.