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Regularization of singularities at corners in two-dimensional Darcy flows[1] ALEXANDER BELOZEROV, NATALIA PETROVSKAYA, YULII SHIKHMURZAEV, School of Mathematics, University of Birmingham, UK — As can easily be shown, for flows past wedges protruding into a porous medium the standard Darcy model produces unphysically singular velocities, thus over-predicting the flow rate and making impossible to describe some flows, e.g. involving wetting fronts, where the pointwise distribution of velocity has to be modelled realistically. A seemingly obvious remedy of smoothing out corners does not apply as, in the real life, the radius of curvature of the tips of such corners can easily be on the pore scale, i.e. zero on the Darcy scale.

A recent study (AIChE J. 63(2017)5207) introduces an approach to the problem where, following a suggestive physical analogy, the permeability even of a spatially uniform porous matrix with respect to a flow is, at every point, a function of the curvature of the flow streamline at this point, decreasing as the curvature increases. This preserves the Darcy model for unidirectional flows, where it has been well-tested, and regularizes 2D flows, where the flow field and the distribution of permeability now become intertwined and have to be found simultaneously.

The new class of models brings in a fundamentally new class of numerical problems. In the present work, we develop a method of handling such problems and highlight some outstanding issues.

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