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On global regularity for the 2D Muskat equations with finite slope

We consider the 2D Muskat equation for the interface between two constant density fluids in an incompressible porous medium, with velocity given by Darcy's law. We establish that as long as the slope of the interface between the two fluids remains bounded and uniformly continuous, the solution remains regular. The proofs exploit the nonlocal nonlinear parabolic nature of the equations through a series of nonlinear lower bounds for nonlocal operators. These are used to deduce that as long as the slope of the interface remains uniformly bounded, the curvature remains bounded. We provide furthermore a global regularity result for small initial data: if the initial slope of the interface is sufficiently small, there exists a unique solution for all time. This is joint work with P. Constantin, F. Gancedo, and R. Shvydkoy.