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Phase-field modeling of two-phase flow in porous media with partial wetting LUIS CUETO-FELGUEROSO, RUBEN JUANES, Massachusetts Institute of Technology — Current models of multiphase flow in porous media implicitly assume complete wetting, and are unable to describe non-spreading systems. This limitation has a direct impact on the ability of current theories to predict complex non-equilibrium processes in porous media, such as flow instabilities or rate-dependent displacement patterns. Here we present a continuum model of two-phase flow in porous media that can describe partially wetting systems. The model is derived within the framework of phase-field modeling. We study unstable two-dimensional flow due to viscous fingering (the instability that ensues when a less viscous fluid displaces a more viscous one in a porous medium). The displacement pattern is characterized by branching structures, with an intrinsic length scale that depends on the fluid properties, essentially viscosity and surface tension between the fluids, as well as the structure of the porous space, the wetting properties of the system, and the injection rate. Using our macroscopic model, we discuss the scaling properties of the intrinsic finger length scale.

Luis Cueto-Felgueroso
Massachusetts Institute of Technology

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