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A finite-element model for moving contact line problems in immiscible two-phase flow ALEC KUCALA, Sandia National Laboratories — Accurate modeling of moving contact line (MCL) problems is imperative in predicting capillary pressure vs. saturation curves, permeability, and preferential flow paths for a variety of applications, including geological carbon storage (GCS) and enhanced oil recovery (EOR). The macroscale movement of the contact line is dependent on the molecular interactions occurring at the three-phase interface, however most MCL problems require resolution at the meso- and macro-scale. A phenomenological model must be developed to account for the microscale interactions, as resolving both the macro- and micro-scale would render most problems computationally intractable. Here, a model for the moving contact line is presented as a weak forcing term in the Navier-Stokes equation and applied directly at the location of the three-phase interface point. The moving interface is tracked with the level set method and discretized using the conformal decomposition finite element method (CDFEM), allowing for the surface tension and the wetting model to be computed at the exact interface location. A variety of verification test cases for simple two- and three-dimensional geometries are presented to validate the current MCL model, which can exhibit grid independence when a proper scaling for the slip length is chosen. Sandia National Laboratories is a multi-mission laboratory managed and operated by National Technology and Engineering Solutions of Sandia, LLC., a wholly owned subsidiary of Honeywell International, Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA-0003525.

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