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Foam–liquid front motion in Eulerian coordinates

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Resumen.
A mathematical model formulated as a system of Hamilton–Jacobi equations describes implicitly the propagation of a foam–liquid front in an oil reservoir, as the zero-level set of the solution variable. The conceptual model is based on the 'pressure-driven growth' model in Lagrangian coordinates. The Eulerian mathematical model is solved numerically, where the marching is done via a finite volume scheme with an upwind flux. Periodic reinitialization ensures a more accurate implicit representation of the front. The numerical level set contour values are initially formed to coincide with an early time asymptotic analytical solution of the pressure-driven growth model. Via the simulation of the Eulerian numerical model, numerical data are obtained from which graphical representations are generated for the location of the propagating front, the angle that the front normal makes with respect to the horizontal and the front curvature, all of which are compared with the Lagrangian model predictions. By making this comparison, it is possible to confirm the existence of a concavity in the front shape at small times, which physically corresponds to an abrupt reorientation of the front over a limited length scale.