Stability of two-phase vertical flow in homogeneous porous media
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flow in porous media, that results from the downward injection of a heavier fluid or
upward injection of a lighter fluid, is characterized by two shocks, one at each end of
a rarefaction wave. The specific details of the saturation profile, such as the shock
speeds and the shock saturations, are determined by the fractional flow function
for given values of the mobility ratio and the gravity number. We employ a nor-
mal mode, matched asymptotic expansion analysis to obtain analytical expressions
governing the stability behavior of such flows. Instability occurs at both ends of
the 1-D base saturation profile with unique characteristics such that, the maximum
growth rate decreases both when the mobility ratio is increased at the front end and
decreased at the back end. This unusual behavior is explained in terms of vorticity
eigenfunctions related to non-monotonic mobility profiles.

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