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Experimental investigation of two-phase flow with a table-top optical scanner: the competition between viscous and gravitational effects under different boundary conditions

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We present experimental results of the development of a hydrodynamic instability in a 3D flow setup in which one fluid phase invades a porous network saturated with another fluid phase. The invading phase is both more viscous and more dense than the defending phase and the developing invasion pattern is governed by the balance between viscous and gravitational forces. The full invading front is made visible by means of a newly developed table-top 3D scanner based on optical index matching and laser-induced fluorescence [1]. The force balance in the problem predicts a transition between a stabilized compact front (viscous dominated flows) and an unstable fingering regime (gravity dominated flows). We consider two inlet boundary conditions that lead to either the flow diverging from a point source or initialized as a flat front. For the latter condition, the invasion front is extracted and we measure its fractal dimension.

Participation

In-Person

References

[1] J. F. Brodin, P. A. Rikvold, M. Moura, R. Toussaint and K. J. Måløy, "Competing Gravitational and Viscous Effects in 3D Two-Phase Flow Investigated With a Table-Top Optical Scanner," Front. Phys. 10, 936915 (2022).

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