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Controlling Viscous Fingering Using Time-dependent Strategies ZHONG ZHENG, HYOUNGSOO KIM, HOWARD STONE, Department of Mechanical and Aerospace Engineering, Princeton University — Control and stabilization of viscous fingering of immiscible fluids impacts a wide variety of pressure-driven multiphase flows. We report theoretical and experimental results on time-dependent control strategy by manipulating the gap thickness $b(t)$ in a lifting Hele-Shaw cell in the power-law form $b(t) = b_1 t^{1/7}$. Experimental results show good quantitative agreement with the predictions of linear stability analysis. By choosing the value of a single time-independent control parameter we can either totally suppress the viscous fingering instability or maintain a series of non-splitting viscous fingers during the fluid displacement process. Besides the gap thickness of a Hele-Shaw cell, in principle, time-dependent control strategies can also be placed on the injection rate, viscosity of the displaced fluid, and interfacial tension between the two fluids.

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