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A Reduced-Physics Model of Hele-Shaw Flow Using Asymptotic Basis Functions KEVIN CASSEL, SHUWANG LI, PEDRO HENRIQUE AMORIM ANJOS, Illinois Institute of Technology — Asymptotic basis functions (ABF) provide a model-driven source of basis functions that can be used in Galerkin projection to form a reduced-physics model (RPM) of complex physical phenomena. The ABF are obtained from an asymptotic analysis, in which each order of the asymptotic expansion, including the corresponding gauge function, gives the ABFs. Hele-Shaw flow provides an interesting and challenging model problem for computing the dynamics of interfacial flows with complex interface topologies that span both linear and nonlinear regimes and includes stable and unstable interface dynamics depending on the time evolution of the gap width. The first several terms in an expansion of the evolution equations for Hele-Shaw flow in the limit of small interface perturbation are used in a Galerkin projection to form a RPM that incorporates both the linear and nonlinear behavior in this limit. Galerkin projection allows for application of the RPM to $O(1)$ values of the interface perturbation length scale that occur over longer evolution times. This approach provides a general framework for the development of physics-based RPM in both regular and singular-perturbation problems, thereby extending their applicability to a broader parameter space.

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