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Collision and coalescence of liquid drops in a dynamically active ambient fluid KRISHNARAJ SAMBATH, School of Chemical Engineering, Purdue University, HARIPRASAD SUBRAMANI, Chevron Energy Technology Company, OSMAN BASARAN, School of Chemical Engineering, Purdue University —
The fluid dynamics of the collision and coalescence of liquid drops has intrigued scientists and engineers for more than a century owing to its ubiquitousness in nature, e.g. raindrop coalescence, and industry, e.g. breaking of emulsions in the oil and gas industry. The complexity of the underlying dynamics, e.g. occurrence of hydrodynamic singularities, has required study of the problem at different scales – macroscopic, mesoscopic and molecular – using stochastic and deterministic methods. In this work, we adopt a multiscale, deterministic method to simulate the approach, collision, and eventual coalescence of two drops where the drops as well as the ambient fluid are incompressible, Newtonian fluids. The free boundary problem governing the dynamics consists of the Navier-Stokes system and associated initial and boundary conditions that have been augmented to account for the effects of disjoining pressure as the separation between the drops becomes of the order of a few hundred nanometers. This free boundary problem is solved by a Galerkin finite element-based algorithm. The approach and results to be reported build on earlier work by Leal and coworkers, and are used to identify conditions conducive for coalescence in terms of flow and fluid properties.

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