Hydrodynamic Interactions Between Deformable Interfaces

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Adjacent interfaces that move relative to one another, thereby displacing an intervening liquid phase, can generate large hydrodynamic forces. Biological interfaces, which are often soft and sometimes sticky, are readily deformed by these lubrication forces. A variety of strongly nonlinear flow-structure interactions then arise, including squeezing, spreading, peeling, choking, sliding, slipping and lift-generating motions. I will illustrate these effects with mathematical models and discuss some of their physiological consequences, which are significant for example in the microcirculation, where deformable cells experience either attractive or repulsive forces with the walls of capillaries, and in lung airways, where inhaled particles interact with airway epithelium.