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Stability of two-layer Couette flow with application to drag reduction.[1] ALIREZA MOHAMMADI, Princeton University, ALEXANDER J. SMITS, Princeton University, Monash University — We consider the linear stability of flows composed of two superposed fluids in Couette flow in order to improve our understanding of the longevity and performance of superhydrophobic surfaces (SHS) or liquid-infused surfaces (LIS) which are important for drag reduction. Here, we assume that the fluids are immiscible, incompressible, and Newtonian with constant properties. Single-fluid Couette flow is known to be linearly stable for any Reynolds number. However, inclusion of the second layer of fluid enriches the problem and introduces five new parameters: viscosity ratio, density ratio, thickness ratio, Froude number and Weber number. Two kinds of instability can appear: an unstable interfacial mode, and a Tollmein-Schlichting mode. In this work we parametrically study the flow stability with specific emphasis on the effects of viscosity ratio, interfacial tension, and thickness ratio.

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