

Route towards droplet formation in laminar separated liquid/liquid flows: analysis and large-scale DNS

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Abstract: We study two-phase liquid-liquid systems where the interface is linearly unstable to small-amplitude perturbations. Although no Squire's theorem exists for the present system, linear theory shows that the most-dangerous modes are typically two-dimensional, and that three-dimensional wavy interfaces are extremely difficult (and often impossible) to realise. Nevertheless, real interfaces do exhibit three-dimensional waves, since otherwise ligaments and droplets would never occur. Using weakly nonlinear theory and large-scale direct numerical simulation, we explain this paradox.