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Resolution Requirements for Direct Numerical Simulation of Unstable Sheared Interfaces SVETLANA SUSHCHIKH, Center for Risk Studies and Safety, Univ. of California, Santa Barbara, ROBERT NOURGALIEV, Idaho National Laboratory, SUTHEE WIRI, Center for Risk Studies and Safety, Univ. of California, Santa Barbara — Direct Numerical Simulations of sheared interfaces in immiscible fluids are discussed, with a particular focus on prediction of interfacial (Yih-) instability in a wide range of flow parameters and wavenumbers. Both, Sharp-Interface (SIM) and Diffuse-Interface (DIM) methods are considered. Using Orr-Sommerfeld analyses for sharp and for diffuse interfaces, we identify the instability-driving, interfacial critical layer mechanism, and we show that a sufficiently thin and resolved diffuse layer can be made to approach a Yih-instability behavior. With SIM, it is found that simply resolving the critical layer (typically 10 nodes over the distance of the critical layer from the interface) is quite sufficient. Providing that the resolved DIM is as good as diffuse-interface Orr-Sommerfeld (O-S) method, the O-S analysis provides guidelines for how thin the diffuse interface should be in order to approach the Yih mode. We find that even with O-S greatly augmented with virtual interfaces and quadruple precision, in many cases the approach to Yih is so gradual in the high wavenumber range so as to remain incomplete and beyond the capability of the computation.

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