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Self-Similar Solutions of Reynolds-Averaged Navier-Stokes Models for Rayleigh-Taylor Instability-Induced Turbulence and Mixing[1] OLEG SCHILLING, Lawrence Livermore National Laboratory — Many applications in which modeling the effects of mixing induced by interfacial hydrodynamic instabilities is important, such as inertial confinement fusion and astrophysics, require a Reynolds-averaged Navier-Stokes (RANS) description due to the prohibitively large range of scales present. In appropriate limits, the RANS equations typically admit self-similar solutions that are useful for developing insights into the late- time behavior of turbulence and mixing. In addition, these solutions provide constraints on model coefficients through large-scale observables, other constraints through coefficient relationships, expressions for closures of the transport equations, and checks on numerical solutions of the full RANS equations. Analytical and semi-analytical solutions of two- equation, and recently proposed three- and four-equation RANS models that include descriptions of scalar turbulence, are derived in various limits for Rayleigh-Taylor instability. The implications of the coefficient constraints on closure modeling of terms in the RANS model are discussed. The results of this study are also related to state-of-the-art simulations and experiments.

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