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Universal Realizable Reynolds Stress Model for Multiphase Fluids CHARLES PETTY, ANDRE BENARD, KARUNA KOPPULA, Michigan State University — The ability to predict the low-order statistical properties of single-phase and multiphase turbulent flows is critical for engineering processes such as mixing and separation of immiscible phases. Although instantaneous phase-averaged equations have been successfully developed over the past thirty years for multiphase fluids, the ensemble-averaged equations for turbulent flows are statistically unclosed. Many researchers use a multiphase eddy viscosity model to relate the Reynolds stress to the local mean strain rate, but this approach is unsuitable for processes where phase separation and mixing by local pressure differences is a significant phenomena. A new closure for the Reynolds stress that is realizable for a wide class of turbulent flows yields a non-linear algebraic relationship between the turbulent momentum flux and a non-negative, symmetric dyadic-valued operator that depends on the mean velocity gradient and a relaxation time associated with the local space-time structure of the turbulence. Benchmark experimental and computational data for single-phase fluids are used to determine the closure parameters in the theory. The presentation will summarize the new approach and its extension to multiphase turbulent flows.

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