

Simulations and Modeling of Turbulent Mixing

Turbulent mixing due to the hydrodynamical Rayleigh-Taylor instabilities occurs in a wide range of scientific and engineering problems such as the formation of gravitational induced mixing in oceanography, performance assessment for inertial confinement fusion and supernovae explosions. The focus is on investigating the behavior of the mixing layer driven by the instabilities and predict the growth rate that describes the outer edge of the mixing zone. In this talk, we introduce the mathematical models and numerical algorithms that are used for the numerical simulations for immiscible and miscible fluids. The essential features of the algorithm used in our studies are front tracking (FT), to achieve resolution of a steep and sharp discontinuity in density gradients, and Large Eddy Simulations (LES) with subgrid scale to model the diffusive transport corrections to the mesh averaged Navier-Stokes equations. We characterize and quantify the effects of uncertainties in model parameters that influence the growth rate. We examine the error bounds and uncertainties for initial conditions in multiple numerical simulations of turbulent mixing for experiments containing pentane/compressed SF₆ and salt/fresh water in rocket tank and present the level of agreement between simulations and experiments.



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Dr. Tulin Kaman is currently an Assistant Professor in the Department of Mathematical Sciences at the University of Arkansas. She is also the holder of the Lawrence Jesser Toll Jr. Chair in the department where she is leading a research program in computational and applied mathematics. Her research focuses on the interfaces of mathematical modeling, numerical methods, high performance parallel computing, uncertainty quantification and simulations of turbulence and mixing in computational fluid dynamics. Her research involves the study of the turbulent mixing and turbulent combustion to understand the physical instability mechanism on the important scientific and engineering problems.

Tulin Kaman received her B.S. in Mathematics from Yildiz Technical University and her M.S. in Computational Science and Engineering from Istanbul Technical University in Turkey. She earned her Ph.D. in Applied Mathematics and Statistics from Stony Brook University in New York, winning the Woo Jong Kim Dissertation Award. Afterwards she was a Paul Scherrer Institute Fellow, a post-doctoral researcher and lecturer in the Department of Computer Science at ETH-Zurich and Institute of Mathematics at the University of Zurich in Switzerland. She is a member of the Society for Industrial and Applied Mathematics (SIAM) and American Mathematical Society. She serves as the faculty advisor of the SIAM Student Chapter at the University of Arkansas, and in 2019 joined the SIAM Membership Committee that provides information and direction to address needs of various segments of membership including students, young professionals, international and industry.