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Initial Conditions and Modeling for Shock Driven Turbulence.

FERNANDO GRINSTEIN, Los Alamos Natl Lab — We focus on the simulation of shock-driven material mixing driven by flow instabilities and initial conditions. Beyond complex multi-scale resolution of shocks and variable density turbulence, me must address the equally difficult problem of predicting flow transition promoted by energy deposited at the material interfacial layer during the shock interface interactions. Transition involves unsteady large-scale coherent-structure dynamics which can be captured by LES, but not by URANS based on equilibrium turbulence assumptions and single-point-closure modeling. Such URANS is frequently preferred on the engineering end of computation capabilities for full-scale configurations – and with reduced 1D/2D dimensionality being also a common aspect. With suitable initialization around each transition – e.g., reshock, URANS can be used to simulate the subsequent near-equilibrium weakly turbulent flow. We demonstrate 3D state-of-the-art URANS performance in one such flow regime. We simulate the CEA planar shock-tube experiments by Poggi et al. (1998) with an ILES strategy. Laboratory turbulence and mixing data are used to benchmark ILES. In turn, the ILES generated data is used to initialize and as reference to assess state-of-the-art 3D URANS. We find that by prescribing physics-based 3D initial conditions and allowing for 3D flow convection with just enough resolution, the additionally computed dissipation in 3D URANS effectively blends with the modeled dissipation to yield significantly improved statistical predictions.

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