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Internal Regulation in Compressible Turbulent Shear Layers[1]
KRISTEN MATSUNO, SANJIVA LELE, Stanford University — High resolution simulations of temporally evolving mixing layers, for convective Mach numbers ranging from $M_c = 0.2$ to $M_c = 2.0$ with density ratios $s = 1$ and $s = 7$, are analyzed to characterize compressibility effects on the structure and evolution of turbulence in this compressible flow. Published experimental results are used to validate simulation results. Examination of the turbulence scales in the present data suggests an internal regulation mechanism. Correlated eddying motions were found to be limited by acoustic signal propagation. Eddy scales in all spatial directions are found to be a progressively smaller fraction of the overall mixing layer thickness with increasing M_c, forming independent layers of eddying motions at high M_c. The behavior of these length scales are interpreted in relation to the 'multi-layered' mixing proposed by Planché (1992) and Day (1998), and the 'sonic eddy hypothesis' by Breidenthal (1992). These reduced spatial scales serve to reduce the effective velocity scale for turbulent motions, suppressed Reynolds stresses, TKE production and dissipation, and the mixing layer thickness growth rate. This talk will focus on this internal scaling based on the effective velocity difference seen by the eddies.

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Kristen Matsuno
Stanford Univ

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