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Effect of velocity ratio on coherent-structure dynamics in turbulent free shear layers[1] SAIKISHAN SURYANARAYANAN, RODDAM NARASIMHA, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore — The relevance of the vortex-gas model to the large scale dynamics of temporally evolving turbulent free shear layers has been established by extensive simulations (Phys.Rev.E 89, 013009, 2014). The effects of velocity ratio ($r = U_2/U_1$) on shear layer dynamics are revealed by spatially evolving vortex-gas shear-layer simulations using a computational model based on Basu et al (Appl.Math.Modelling 19, 1995), but with a crucial improvement that ensures conservation of global circulation. The simulations show that the initial conditions and downstream boundaries can significantly affect the flow over substantial part of the domain, but the equilibrium spread rate is a universal function of r, and is within the experimental scatter. The spread in the $r = 0$ limit is higher than Galilean-transformed temporal value. The present 2D simulations at $r = 0$ show continuous growth of structures, while merger-dominated evolution is observed for $r = 0.23$ (and higher). These two mechanisms were observed across the same two values of r in the experiments of D'Ovidio & Coats (J.Fluid Mech 737, 2013), but the continuous growth was instead attributed to mixing-transition and 3D. The 2D mechanisms responsible for the observed continuous growth of structures are analyzed in detail.

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Saikishan Suryanarayanan
Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore

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