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Turbulent wedge spreading dynamics and control strategies.[1]
SAIKISHAN SURYANARAYANAN, DAVID GOLDSTEIN, Univ of Texas, Austin, GARRY BROWN, Princeton University — Turbulent wedges are encountered in some routes to transition in wall bounded flows, particularly those involving surface roughness. They are characterized by strongly turbulent regions that are formed downstream of large disturbances, and spread into the non-turbulent flow. Altering the wedge spreading mechanism is a possible drag reduction strategy. Following recent studies of Goldstein, Chu and Brown (Flow Turbul. Combust. 98(1), 2017) and Kuester and White (Exp. Fluids 57(4), 2016), we explore the relation between the base flow vorticity field and turbulent wedge spreading using immersed boundary direct numerical simulations. The lateral spreading rate of the wedges are similar for high Reynolds number boundary layers and Couette flow, but differences emerge in wall normal propagation of turbulence. We also attempt to utilize the surface texture based strategy suggested by Strand and Goldstein (J. Fluid Mech. 668, 2011) to reduce the spreading of isolated turbulent spots, for turbulent wedge control. The effects of height, spacing and orientation of fins on the dynamics of wedge evolution are studied. The results are interpreted from a vorticity dynamics point of view.

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