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Uniform momentum zones in turbulent boundary layers
CHARITHA DE SILVA, IVAN MARUSIC, NICHOLAS HUTCHINS, Univ of Melbourne — We examine the properties of large regions of uniform streamwise momentum in turbulent boundary layers using databases obtained from particle image velocimetry that extend over 2.3 δ (where δ denotes the boundary layer thickness) in the streamwise direction and 1.2 δ in the wall-normal direction. The investigation covers a large range of Reynolds numbers, spanning more than an order of magnitude ($Re_\tau = 10^3 - 10^4$), but with adequate spatial resolution to resolve most structural features. This enables accurate descriptions of the structural evolution of the uniform momentum zones (UMZs) as a function of Reynolds numbers. Our analysis reveals evidence of a hierarchical length scale distribution of structures within turbulent boundary layers, leading to zonal-like organisations. The Reynolds number dependence of these features is also investigated. Interpretation of these results is aided by employing synthetic velocity fields generated by using the attached-eddy model. Comparisons between the model and experimental results show that the widely proposed packet model would lead to a distribution of UMZs that conforms closely to those observed experimentally in this study.

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