

Abstract Submitted
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Essential Development of Streamwise Vortical/Secondary Flows in All Ducts with Corners or Slope Discontinuities in Perimeter HASSAN NAGIB, ALVARO VIDAL, IIT, Chicago, RICARDO VINUESA, PHILIPP SCHLATTER, KTH, Stockholm — Direct numerical simulations of fully-developed turbulent flow through various straight ducts with sharp or rounded corners of various radii were performed to study influence of corner geometry on secondary flows. Unexpectedly, increased rounding of corners in rectangular ducts does not lead to monotonic trend towards pipe case. Instead, secondary vortices relocate close to regions of wall-curvature change. This behavior is connected to inhomogeneous interaction between near-wall bursting events, which are further characterized in this work with definition of their local preferential direction, and vorticity fluxes. Although these motions are relatively weak compared to streamwise velocity their effect on turbulence statistics and shear-stress distribution is very important and has not been sufficiently documented or fully understood. Flow through spanwise-periodic channels, with sinusoidal function to define the geometry of wall, $y_w = \pm h + A \cos(\omega z)$, was also studied as model flow that is parametrically changed using A and ω , while taking advantage of many resulting symmetries. Consequences on experimental facilities and comparisons between experiments and various numerical and theoretical models are discussed revealing the uniqueness of pipe flow.

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