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Coherent structures in turbulent rectangular duct flows HASSAN NAGIB, IIT, Chicago, RICARDO VINUESA, KTH, Stockholm and IIT, Chicago, CEZARY PRUS, PHILIPP SCHLATTER, KTH, Stockholm — Turbulent duct flows computed by means of DNS with spectral element code Nek5000 are analyzed to characterize coherent structures present in this flow. A number of aspect ratio (defined as duct width over height) cases ranging from 1 to 18 at two different Reynolds numbers ($Re_\tau \simeq 180$ and 330) constitute the data set under study. Common methods for coherent vortex identification (λ_2, Q, λ_{ci} and Δ), together with a less widely used approach by Kida and Miura, are used to characterize the structures in the various duct cases. All methods yield very similar results, and identify the occurrence of buffer layer vortices along the horizontal and side walls, with the well-documented spacing between streaks of $\simeq 100^+$. Secondary vortices in the duct corners are only found from two-dimensional fields when averaged over time and streamwise computational domain. The results indicate that the corner vortices may exhibit much slower time-scales than buffer layer vortices. The concept of turbulent net force is also applied to the 2D fields to assess impact of the corner vortices on the flow. The main features of these structures are compared with the ones found in spanwise-periodic turbulent channel flows at the same Reynolds numbers.

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