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Investigation of large-scale features in turbulent duct flows

HENRY NG, JASON MONTY, NICHOLAS HUTCHINS, MIN CHONG, IVAN MARUSIC, The University of Melbourne, BHARATHRAM GANAPATHISUBRAMANI, Imperial College — Recent studies reveal that long low-speed meandering structures (referred to as “superstructures” or Very Large Scale Motions) exist in the log region of fully developed turbulent pipe and channel flows as well as the turbulent boundary layer. These studies have been carried out using hot-wire arrays which are physically limited in terms of wall proximity. Here we use an array of multiple wall skin friction sensors to study the “footprint,” that is, the influence of these large scale features at the wall. Hot-wire velocity profiles measured in conjunction with the multiple skin-friction sensor array are used to study the three dimensional coherence of the large scale structure and the ensemble averaged statistics. Experiments are carried out in fully developed turbulent pipe and channel flow facilities with a similar outer length scale (pipe radius, $R = 49.4\text{mm}$ and channel half height, $h = 50\text{mm}$) enabling direct comparison of the flows at a matched Reynolds number.

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