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Towards data-driven modelling of coherent motions in wall turbulence[1] RAHUL DESHPANDE, DILEEP CHANDRAN, JASON MONTY, IVAN MARUSIC, The University of Melbourne — The present work reports a set of unique multi-point hotwire measurements conducted in a high Reynolds number turbulent boundary layer, aimed at facilitating coherent structure-based modelling of a wall-bounded flow. The synchronous hotwire signals are used to compute the two-dimensional (2-D) cross-spectra of the streamwise velocity as a function of streamwise wavelength, spanwise wavelength and wall-normal separation. This 2-D cross-spectrum isolates the structures that are coherent across the chosen wall-normal separation, and indicates their scale-specific energy contributions as well as 3-D geometrical characteristics. Therefore, with a careful selection of the measurement locations, we are able to directly isolate contributions from the statistically relevant coherent motions in the logarithmic region, i.e., (i) the self-similar wall-coherent motions associated with Townsend's attached eddies, and (ii) the tall non-self-similar but wall-coherent superstructures. The 3-D geometrical interpretations of these coherent motions can be utilized in coherent structure-based models, such as the attached eddy model, and used to predict turbulence statistics at very high Reynolds numbers, relevant to atmospheric boundary layer investigations.

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