Abstract Submitted
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Direct measurement of the velocity joint probability density function and higher order moments in turbulent boundary layer flows[1] JULIO SORIA, CALLUM ATKINSON, Monash University — This work shows how the joint probability density function (JPDF) of the streamwise and wall normal velocity components of a zero-pressure gradient turbulent boundary layer (ZPG-TBL) can be directly measured using the methodology and theoretical framework proposed by Soria & Willert (2012) MST 23, 065301. Higher order moments including Reynolds stresses can be computed directly from two-component (2C) JPDFs of the streamwise and wall normal velocity components by taking moments of the 2C-JPDF. The base data for the direct measurement of the 2C-JPDF are single-exposed image pairs typically used to determine instantaneous 2C-2D particle image velocimetry (PIV) fields. However, in the new direct measurement method, the instantaneous velocity samples necessary to build up the JPDF never need to be determined, which avoids the problems in PIV due to large velocity gradients that are typically encountered in turbulent wall-bounded flows. This new method has been applied to single-exposed image pairs acquired over a range of Reynolds numbers ranging up to $Re_\tau = 19500$ in ZPG-TBL experiments. This paper presents directly measured 2C-JPDFs across the ZPG-TBL as well as higher moment distributions determined from these 2C-JPDFs.

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