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Vortex properties in turbulent boundary layers[1] QI GAO, NEELAKANTAN SAIKRISHNAN, CECILIA ORTIZ-DUENAS, ELLEN LONGMIRE, Aerospace Engineering and Mechanics, University of Minnesota — Swirl strength was used to identify vortices in turbulent boundary layers. Dual-plane PIV data at $Re_\tau \approx \$1100$ with coarser (Ganapathisubramani et al., 2006) and finer resolution (Saikrishnan et al., 2007) as well as DNS data at Re_τ=590 (Moser et al., 1999) and Re_τ=934 (del Álamo et al., 2004) were analyzed. A new core-combination algorithm was developed to improve identification of in- and out-of-plane vortices. Core orientation was determined by the eigenvector of the velocity gradient tensor, and core radii were characterized. The effects of wall normal location, Reynolds number, and spatial resolution were studied. In general, the PDF of swirl magnitude is affected by both in- and out-of-plane spatial resolution as well as the wall normal location. Scaling of swirl will be discussed in the presentation. The results show that, in the logarithmic region, the mean angle between the eigenvector and the vorticity vector decreases and the mean core radius increases with wall normal distance. Joint PDFs show linear increases in circulation with core radius, as well as correlations between core inclination angle and circulation. Convection velocities of strong cores are typically smaller than the local mean velocity.

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