

Abstract Submitted
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Analysis of vortex populations in turbulent boundary layers based on tomographic PIV¹ QI GAO, CECILIA ORTIZ-DUENAS, ELLEN LONGMIRE, AEROSPACE ENGINEERING AND MECHANICS, UNIVERSITY OF MINNESOTA TEAM — Vortex populations in the logarithmic region of turbulent boundary layers were investigated using results from tomographic PIV. The experiments were carried out in a water channel facility with $\delta \approx 125$ mm and $Re_\tau \approx 2500$ ($Re_\theta \approx 6200$). Measurement volumes were about $90 \times 80 \times 9$ mm³ ($1650 \times 1470 \times 130$ viscous units) spanning a wall-normal range from $z^+ = 150$ to 280. Four 2K x 2K cameras were mounted above the channel and aimed at the measurement volume with tilt angle about 30 degrees to the wall normal direction. The magnification was 0.07 mm/pixel. Correlations were performed on $48 \times 48 \times 48$ voxel volumes with 75% overlap yielding a vector spacing of $17 \times 17 \times 17$ viscous units. Swirl strength and swirl direction were used to identify and characterize vortices in terms of orientation, circulation, size, and convection velocity. The results showed that swirl direction was a better indicator than vorticity of eddy orientation. Eddy circulation was found to increase approximately quadratically with eddy radius. The advantages and limitations of tomographic PIV vs. dual plane PIV will be discussed.

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