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Combined High-Speed 3D Scalar and Velocity Reconstruction of Hairpin Vortex[1] DANIEL SABATINO, TOBIAS ROSSMANN, XUANYU ZHU, MARY THORSEN, Lafayette College — The combination of 3D scanning stereoscopic particle image velocimetry (PIV) and 3D Planar Laser Induced Fluorescence (PLIF) is used to create high-speed three-dimensional reconstructions of the scalar and velocity fields of a developing hairpin vortex. The complete description of the regenerating hairpin vortex is needed as transitional boundary layers and turbulent spots are both comprised of and influenced by these vortices. A new high-speed, high power, laser-based imaging system is used which enables both high-speed 3D scanning stereo PIV and PLIF measurements. The experimental system uses a 250 Hz scanning mirror, two high-speed cameras with a 10 kHz frame rate, and a 40 kHz pulsed laser. Individual stereoscopic PIV images and scalar PLIF images are then reconstructed into time-resolved volumetric velocity and scalar data. The results from the volumetric velocity and scalar fields are compared to previous low-speed tomographic PIV data and scalar visualizations to determine the accuracy and fidelity of the high-speed diagnostics. Comparisons between the velocity and scalar field during hairpin development and regeneration are also discussed.

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