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Image preprocessing method for particle image velocimetry (PIV) image interrogation near a fluid-solid surface YIDING ZHU, LICHAO JIA, YE BAI, HUIJING YUAN, CUNBIAO LEE, Peking Univ — Accurate particle image velocimetry (PIV) measurements near the moving wall are a great challenge. The problem is compounded by the very large in-plane displacement on PIV images commonly encountered in measurements of the high speed flow. An improved image preprocessing method is presented in this paper. A wall detection technique is used first to qualify the wall position and the movement of the solid body. Virtual particle images are imposed in the solid region, of which the displacements are evaluated by the body movement. The estimation near the wall is then smoothed by data from both sides of the shear layer to reduce the large random uncertainties. Interrogations in the following iterative steps then converge to the correct results to provide accurate predictions for particle tracking velocimetries (PTV). Significant improvement is seen in Monte Carlo simulations and experimental tests such as measurements near a flapping flag or compressor plates. The algorithm also successfully extracted the small flow structures of the 2nd mode wave in the hypersonic boundary layer from PIV images with low signal-noise-ratios (SNR) when the traditional method was not successful.

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