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Quantification and correction of the error due to limited PIV resolution on the accuracy of non-intrusive spatial pressure measurement using a DNS channel flow database XIAOFENG LIU, SETH SIDDLE-MITCHELL, San Diego State University — The effect of the subgrid-scale (SGS) stress due to limited PIV resolution on pressure measurement accuracy is quantified using data from a direct numerical simulation database of turbulent channel flow (JHTDB). A series of 2000 consecutive realizations of sample block data with 512x512x49 grid nodal points were selected and spatially filtered with a coarse 17x17x17 and a fine 5x5x5 box averaging, respectively, giving rise to corresponding PIV resolutions of roughly 62.6 and 18.4 times of the viscous length scale. Comparison of the reconstructed pressure at different levels of pressure gradient approximation with the filtered pressure shows that the neglect of the viscous term leads to a small but noticeable change in the reconstructed pressure, especially in regions near the channel walls. As a contrast, the neglect of the SGS stress results in a more significant increase in both the bias and the random errors, indicating the SGS term must be accounted for in PIV pressure measurement. Correction using similarity SGS modeling reduces the random error due to the omission of SGS stress from 114.5% of the filtered pressure r.m.s. fluctuation to 89.1% for the coarse PIV resolution, and from 66.5% to 35.9% for the fine PIV resolution, respectively, confirming the benefit of the error compensation method and the positive influence of increasing PIV resolution on pressure measurement accuracy improvement.

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