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Assessment of three-dimensional density measurements from tomographic background-oriented schlieren (BOS)[1] SHOAIB AMJAD, SHAHRAM KARAMI, JULIO SORIA, CALLUM ATKINSON, Monash University — Tomographic background-oriented schlieren (TBOS) is used to measure 3D instantaneous density fields in turbulent flows. TBOS uses the Gladstone-Dale relation between fluid density and refractive index (RI) to obtain the 3D density field based on images looking through a flow, which capture information on path-integrated RI gradients from background image displacements. We examine four error sources: i) defocus blurring; ii) spatial averaging in the solution; iii) limited-view tomographic reconstruction; and, iv) displacement field noise. Synthetic BOS displacements are generated by raytracing through the refractive index field of a heated jet DNS at Re = 5000 and jet exit centreline-to-ambient density ratio of 0.83. The virtual BOS setup uses 15 cameras placed circumferentially around the jet. We show defocus blurring has the greatest impact on accuracy, especially near the nozzle. Sources ii) and iv) have marginal impact. Three reconstruction methods are tested: i) filtered back-projection (FBP); ii) an algebraic reconstruction technique (ART); and, iii) sequential FBP-ART. ART and FBP-ART are similarly accurate, with under half the error of FBP, which suffers from significant reconstruction artefacts. Reconstruction error is modest compared to the impact of defocus blurring.

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