Weighted Least squares density reconstruction for Background Oriented Schlieren (BOS)[1] LALIT RAJENDRAN, JIACHENG ZHANG, SALLY BANE, PAVLOS VLACHOS, Purdue University — Background Oriented Schlieren (BOS) is an optical technique used to measured density gradients by tracking the apparent distortion of a dot pattern. The density gradient field can then be spatially integrated to calculate the density field. The Poisson solver is currently the standard for density integration, but it is sensitive to noise in the gradient field. We address this limitation and improve the overall accuracy of the density integration process by employing a weighted least-squares (WLS) method. WLS performs the 2D integration of a gradient field by solving an over-determined system of equations. Weights are assigned to the grid points based on errors/uncertainties in the density gradient field to ensure that a less reliable measurement point is given less weight on the integration procedure. This method has been shown to increase the robustness of the integration in velocity-based pressure estimation, and in this study we will assess its suitability for BOS. We will assess the calculation of weights based on two methods: (1) based on the displacement uncertainty and (2) using a curl-free constraint on the density gradient field, as the underlying density field is a scalar. The contribution is an improved integration method for density estimation from BOS.

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