Assessment of sources of error in Background Oriented Schlieren (BOS) measurements LALIT RAJENDRAN, BHAVINI SINGH, MATTHEW GIARRA, SALLY BANE, PAVLOS VLACHOS, Purdue University — Background Oriented Schlieren (BOS) is used to measure density gradients in a flow by tracking the apparent distortion of a target dot pattern. The quality of a BOS measurement depends on several factors such as the dot pattern, illumination, density gradients, optical system, cross-correlation algorithms and density reconstruction. To understand their contributions to the final error in the measurement and to develop an optimal set of design rules, we generate high fidelity synthetic images using ray tracing simulations. Past studies use ad-hoc models (or none) for simulating these effects and do not represent the issues introduced in a typical BOS setup, thereby limiting their utility. We have developed and implemented an image generation methodology based on ray tracing, where light rays emitted from a dot pattern are traced through the experimental setup including the density gradients, to generate high fidelity images representative of a real experiment. We apply this methodology to perform a comprehensive analysis of the various sources of error in the BOS technique and to better understand the issues involved in designing a successful experiment. The results of this study can guide future experiments and provide directions to improve the image analysis tools.

Lalit Rajendran
Purdue University

Date submitted: 01 Aug 2016   Electronic form version 1.4