Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Modern quantitative schlieren techniques MICHAEL HARGATHER, GARY SETTLES, Pennsylvania State University — Schlieren optical techniques have traditionally been used to qualitatively visualize refractive flowfields in transparent media. Modern schlieren optics, however, are increasingly focused on obtaining quantitative information such as temperature and density fields in a flow – once the sole purview of interferometry – without the need for coherent illumination. Quantitative data are obtained from schlieren images by integrating the measured refractive index gradient to obtain the refractive index field in an image. Ultimately this is converted to a density or temperature field using the Gladstone-Dale relationship, an equation of state, and geometry assumptions for the flowfield of interest. Several quantitative schlieren methods are reviewed here, including background-oriented schlieren (BOS), schlieren using a weak lens as a "standard," and "rainbow schlieren." Results are presented for the application of these techniques to measure density and temperature fields across a supersonic turbulent boundary layer and a low-speed free-convection boundary layer in air. Modern equipment, including digital cameras, LED light sources, and computer software that make this possible are also discussed.

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Date submitted: 05 Aug 2010 Electronic form version 1.4