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12.26 An optical offset method for increased dynamic range in schlieren imaging systems

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High-temperature, atmospheric-pressure plasma systems operated in molecular gases present complex diagnostic challenges. Schlieren imaging is a technique that can be used to quantitatively measure the density of a gas stream through interpretation of directly-measured deflections from a collimated light source. The presence of hydrodynamic shocks presents a unique challenge to the accuracy of these measurements due to the wide dynamic range needed from the instrument. Schlieren imaging systems can achieve wide instrument ranges or high-accuracy measurements through adjustment of the aperture-cutoff, but achieving both simultaneously requires high-bit depth sensors. An alternative method is to make use of an optical offset system. A schlieren system has been designed with a large-area, rotatable wedge prism that produces an angle-dependent offset at the schlieren analyzer. With the use of a knife-edge analyzer, the system depends only on one component of the offset. In this manner, a high-accuracy measurement region can be “scanned” through a wider range, effectively increasing the dynamic range of the instrument without the use of a high-bit depth detector. Design and operation of the system using a 100mm, 900 arcsec. wedge prism is shown.

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