Background-oriented schlieren tomography

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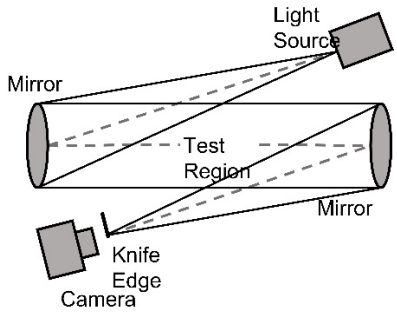
Schlieren imaging is a method used for investigating nonuniform media in certain systems or environments. As such, it is a way to view particles that are in variable velocities or nonconstant motion within a system. For example, the sight of fluids, light refraction, or the heat coming from a car that has been in the sun. All these contain a change in the air density around them. Schlieren imaging is a way to distinctly view the changes in transparent media and visibly see the changes in the refracting of light, flow density in a qualitative manner, and observe air density by using light, mirrors, and a knife edge. The inhomogeneities stated are focused differences in an optical or visual path that causes light to behave and move differently.



Schlieren Imaging Setup

The traditional schlieren setup generally consists of a light source, lens, camera, and sharp knife edge. Background-oriented schlieren tomography (BOST) method utilizes the deflection of rays passing through an inhomogeneous field for measurement. The BOST is effective for flow field measurement. This effect is generated by a density variation between the light source and a surface of homogeneous brightness and color. The light intensity variations at each location of the surface are proportional to the second derivative of the air density between the light source and the surface.

This research seeks to investigate the photoacoustic signal using schlieren imaging, which provides a path to visualize what is happening within the system. Schlieren imaging creates a way to visualize the flow of air and produce sound waves and, with this, the amplitude of the photoacoustic signal can not only be recorded and heard, but also visually seen. The changes in optical density will be seen in the imaging method and will provide a qualitative measure to the experiment. Schlieren methods will ensure that photoacoustic signals that are being heard and recorded are also seen. It is a method compatible with the high intensities of the harmonic resonance signals. The benefits of schlieren imaging would provide a visual aid for real-life changes in the air and it is important to understand what one may not always be able to see. There are noises and variable fluctuations every day, and this method of experimentation can further understand what is happening in different surroundings and environments.

The student will learn how to build up experimental setup with optics, operate lasers and analyze data. The student will also be required to present the work at the Southeastern Regional Meeting of the American Chemical Society (SERMACS) held in Atlanta, GA in 2024.