Background-Oriented Schlieren Imaging of In-Cylinder NG Fuel Jets

Student: Ena Stanic
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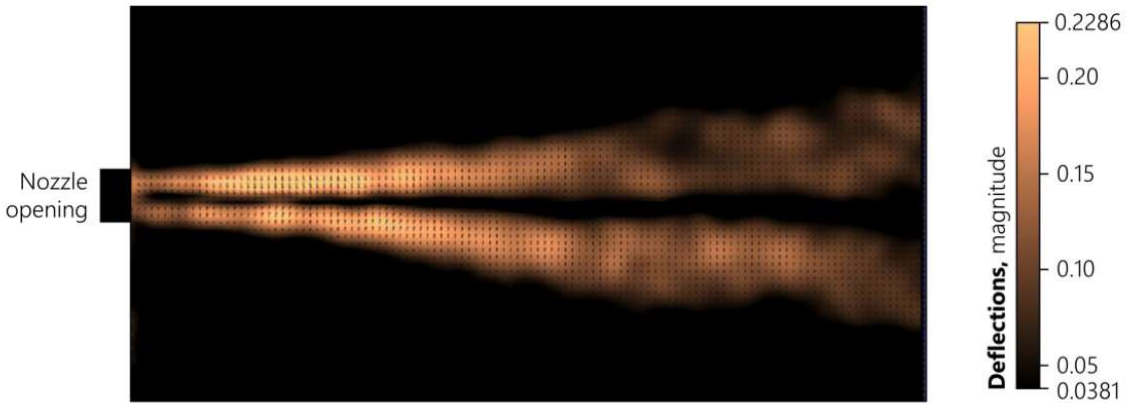

Figure 1 *Deflections shown for a CO_2 jet originating at the left edge of the panel, acquired using BOS imaging. Color scale indicates the magnitude of the deflections and arrows indicate the direction. A pressure ratio of 2.06, and a nozzle diameter of 0.75mm were used.*

A background-oriented Schlieren (BOS) diagnostic was developed for the imaging of under-expanded gaseous jets, for ultimate application to in-cylinder natural gas jet measurements. An experimental benchtop setup was configured and optimized using available hardware, to simulate the experimental conditions of the diagnostic's extended application to the Clean Energy Research Centre's optical engine. Conditions include geometric limitations, high frame rates, and low exposures. Pressure and distance sweeps were performed to probe varying and engine-relevant degrees of under-expansion in the gas jets tested, while assessing the effects of slight changes in refracted ray length on the strength of displacement outputs. As limited by the current system magnification and low pixel to mm ratio, sub-structures such as shock cells and Mach disks were not successfully visualized using the diagnostic. Using image pre-processing techniques, the recorded signal was decomposed into a separate noise signal, including background flickering and a 40.0097Hz periodic dimming of the image intensity, along with the measured signal itself. Several recommendations are provided for further development of the diagnostic, with the aim of addressing key limitations such as background noise and limited system magnification.