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X-ray and laser investigation of high pressure sprays

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ABSTRACT

The diagnostics of multiphase flows is important to understand the correlation of parameters such as nozzle geometry, flow velocity, liquid breakup characteristics, atomization, and mass distribution. Investigation of each of these parameters can lead to various improvements on design and optimization, for example, of combustion in gas turbines and rocket engines. For this project, the X-ray and optical diagnostics of multiphase flows in propulsion is investigated for high pressures. Two x-ray tube sources are used to illuminate the spray, and the images are captured on phosphor plates coupled to high-speed cameras. Reconstruction of the mass distribution is accomplished using computer analysis by applying Beer's-Lambert law. High temporal resolution and spatial resolution images were collected of various sprays composed of water and KI solutions for development and characterization of the technique with different window materials typically used in high-pressure vessels. Laser-based fluorescence was tested in vaporized jet-A fuel in a high-pressure vessels. The implications for X-ray and laser analysis of multiphase flows in sprays with high spatial and temporal resolution and high signal to noise ratio are investigated.

KEYWORDS

X-ray imaging, radiography, multiphase-flow, atomization, , Beer's-Lambert Law, Kramer's Law, laser-induced fluorescence