The Summer Undergraduate Research Fellowship (SURF) Symposium
2 August 2018
Purdue University, West Lafayette, Indiana, USA

Two-Phase Flow Visualization of Evaporating Liquid Fuels at Atmospheric Pressure

Junchao Ma, Terrence Meyer
School of Mechanical Engineering, Purdue University
Venkatasubramanian Athmanathan, Alber Douglawi
School of Aeronautics and Astronautics Engineering, Purdue University

ABSTRACT

Two-phase flow visualization of fuel sprays is important for the design of better engines because it determines the efficiency and emissions of the combustion process. Simultaneous two-phase flow imaging using techniques such as planar laser-induced fluorescence (PLIF) has been a challenge due to the large variation in LIF signals from the gas and liquid phases. After laser excitation, the liquid signal initially overwhelms the gas phase signal due to its higher number density. However, the liquid signal quenches dramatically due to quenching effects that dominate the liquid LIF signal. By applying the novel concept of temporal filtering, separation of liquid and vapor signal can be achieved using different time delayed camera systems. The optical measurement provides a non-intrusive means of obtaining the liquid and vapor distributions in a spray. The experiment is performed using an ultraviolet beam from a burst-mode Nd:YAG laser in combination with two intensified cameras that are timed to maximize either the liquid or vapor phase signal. The setup is complemented by a drop generator and vaporizer flow system to allow studies of aviation fuels such as Jet-A or JP10, as well as reciprocating engine fuels such as diesel or toluene (as a surrogate for gasoline).

KEYWORDS

Planar Laser-Induced Fluorescence, Two-Phase Flow Visualization, Spray, Combustion, Laser Diagnostics