Engine Combustion Network: "Spray A" basic measurements and advanced diagnostics

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Abstract

Diesel spray experimentation at controlled high-temperature and high-pressure conditions is intended to provide a more fundamental understanding of diesel combustion than can be achieved in engine experiments. The Engine Combustion Network (http://www.sandia.gov/ecn) has recently become a leading group in performing comparative studies under standardized conditions by using constant-volume pre-combustion vessels and constant flow test rigs. The purpose of this collaborative effort is to generate a high-quality dataset to be used for advanced computational model development under relevant modern diesel engine conditions.

In this study the pre-burn combustion vessel at IFPEN is used to analyze "spray A" conditions (n-dodecane, 900 K, 22.8 kg/m^3, 15% oxygen). The fuel spray is characterized by applying several advanced optical diagnostic techniques. However before any spray related measurements are executed, boundary conditions inside the vessel are analyzed in great detail. The ambient gas temperature distribution before the fuel injection is measured using fast response thermocouples. The fuel temperature inside the injector is measured and then stabilized by implementing several hardware upgrades. Particle Image Velocimetry (PIV) measurements are taken in order to define ambient gas velocities inside the vessel right before fuel injection.

The spray penetration length over time is analyzed using high-speed Schlieren diagnostics. An optimized backlight illumination set-up is implemented as a replacement of the previously used Mie scattering technique. PIV measurements for reacting and non-reacting sprays are carried out to analyze the fuel spray velocities during an injection event. High-speed imaging of light luminosity and the implementation of various optical filters provides information to define the ignition delay time, ignition location and Flame Lift Off (FLO) locations.

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