Recent Findings on Laser Plasma Formation and Combustion Ignition

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Colorado State University
4:00 pm, Monday, January 30, 2017
Refreshments at 3:45 PM
Location: 120 Engineering (Hammond Auditorium)

Abstract

The use of laser induced plasmas for ignition is of interest for a number of practical applications including reciprocating gas engines, aero-turbines, and rocket engines, with potential benefits including increased combustion efficiency, reduced pollutant emissions, and increased reliability. The laser plasmas are formed by focusing relatively high peak-power pulsed sources into the air fuel mixture. Depending on the wavelength and pulse duration, different mechanisms are responsible for the plasma generation. I will summarize our recent studies on laser plasma formation with ultraviolet and near-infrared nanosecond pulses. Measurements of energy absorption, optical luminosity, and Rayleigh scattering thermometry show different threshold behaviors for different pulse conditions. I will also present results of combustion ignition using new dual-pulse multi-wavelength schemes. By adding the laser energy from different pulses the early flame kernel growth can be controlled. The final part of the talk will examine development of candidate laser systems, including fiber optic delivery, for ignition of real world combustion devices.

Biographical Sketch

Azer Yalin has been a Professor in the Department of Mechanical Engineering at Colorado State University (CSU) since 2002. He received his undergraduate degree in Engineering Physics from Queen's University in 1995, and Masters and PhD degrees from the Department of Mechanical and Aerospace Engineering at Princeton University in 1997 and 2000 respectively. From 2000 to 2002, he held a post-doctoral position at Stanford University in the Departments of Mechanical
Engineering and Chemistry. His current research focuses on laser-based diagnostics and non-intrusive measurements of gases and plasmas. Other interests include applications of lasers and plasmas to combustion, especially laser ignition of engines, and laser sensing for atmospheric science. His awards include the Bronze Educational Award from Edmund Optics (2014), the Ralph R. Teetor Educational Award (Aerospace area - 2009) from SAE, and the George T. Abell Outstanding Teaching & Service Faculty Award (2012) from CSU's College of Engineering. He is an Associate Fellow of the AIAA and senior member of OSA.