A Characterization of Different Spark Regimes for Ignition Delay Comparison with Conventional Spark Plugs

Zachary M. Wozniak[1], Jesse C. Burton[2], Cameron J. Hedrick[3], Qiuyu Deng[3], and Daniel W. Robinson[3], Department of Mechanical Engineering, Purdue School of Engineering and Technology, Indiana University-Purdue University Indianapolis, Indianapolis, IN 46202

The introduction of plasma into combustion and ignition processes has continuously proved to be advantageous when compared to the conventional spark ignition in a wide range of categories. From the capability to ignite leaner mixtures and improve fuel economy to an effective reduction of hazardous emissions and ignition delay, the benefits of integrating non-equilibrium plasma can be utilized for numerous applications including hot jet ignition. Detailed design specifications for the electrode configuration, circuit schematic, and combustion rig are developed and presented. Using a CCD camera and high performance oscilloscope, this paper aims to identify, characterize, and compare the different effects of frequency and pulse width of a driver circuit on the plasma sparks quantitatively in terms of the current, voltage, and energy attributes. Four different plasma regimes are investigated with frequencies ranging from 5.44 Hz to 95.46 kHz and pulse energies ranging from 168 μJ to 14.42 J. The maximum voltage and current characteristics of the plasmas indicate a glow discharge referencing previous experiments. Future work is laid out for a comparison of the ignition progression between a non-thermal plasma system and a traditional spark with using Schlieren imaging.

Mentors: Ali T. Kojok[3]; Mohammad E. Feyz[3]
Advisor: Razi Nalim[3]

[1]Department of Physics, Purdue School of Science, Indianapolis, IN 46202
[2]Department of Electrical and Computer Engineering, Purdue School of Engineering and Technology, Indianapolis, IN 46202
[3]Department of Mechanical Engineering, Purdue School of Engineering and Technology, Indianapolis, IN 46202