Announcing the Final Examination of Andrew Laich for the degree of Master of Science

Time & Location: November 4, 2019 at 9:00 AM in HEC 113
Title: The Oxidation of Bio-Ethanol Mixtures at High-Pressure Engine Conditions: A Shock Tube and Laser Absorption Study

Ethanol (C2H5OH) is a prominent renewable fuel, which is a key component of the U.S. Department of Energy’s Co-Optima program, that can be produced in a sustainable manner and used as a neat fuel or additive in spark ignition (SI) engines for octane boosting. With the addition of alcohols such as ethanol in fuel blends, a reduction in harmful emissions, polyaromatic hydrocarbons, particulates, and soot can be realized. In the literature there are many studies investigating the chemical kinetics of ethanol at low and high pressures, however, time-resolve measurements at engine conditions are lacking. Therefore, carbon monoxide time-histories and ignition delay times were studied behind reflected shock waves in UCF’s shock tube during ethanol oxidation. Experimental conditions included reflected shock temperatures (T5) and pressures (P5) of 960 – 1580 K and 17.8 – 23.9 atm, respectively. Mixtures consisted of 6.54% ethanol at an equivalence ratio of 1 balanced in nitrogen, and 0.25% ethanol at equivalence ratios of 0.5 and 1 balanced in argon. During oxidation experiments of the high fuel loading mixture, only ignition delay times were measured, which revealed early energy release, indicative of preignition. These experiments were interpreted as a transition from mild to strong ignition, where ignition started off as inhomogeneous, but quickly transitioned to a strong ignition event. Measured carbon monoxide concentration profiles were compared to several chemical kinetic mechanisms in the literature assuming a constant internal energy and volume model for the test gas. These comparisons in addition with sensitivity and pathway analyses for carbon monoxide revealed low temperature sensitivity to several intermediate reactions, which emphasized the importance of ethanol decomposition reactions to the formation of intermediate species. Such insights into ethanol fuel chemistry can provide important information for continued refinement of the chemical kinetic mechanisms, which was the aim of this work.

Major: Mechanical Engineering

Educational Career:
Bachelor’s of Mechanical Engineering, BS, 2017, University of Michigan - Dearborn

Committee in Charge:
Subith S. Vasu, Chair, Mechanical and Aerospace Engineering
Louis Chow, UCF MAE/CECS
Jayanta Kapat, UCF MAE/CECS

Approved for distribution by Subith S. Vasu, Committee Chair, on October 21, 2019.

The public is welcome to attend.