The Department of Mechanical Engineering/College of Engineering and Applied Sciences

Stony Brook University

Mechanical Engineering Seminar

Faculty Candidate

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PhD candidate in Mechanical Engineering from Texas A&M University

Lecture Title: A versatile computationally efficient combustion trajectory model for diesel combustion

Wednesday, April 16, 2014 at 2PM, Room 173 Light Engineering Building

Abstract

The combustion process in internal combustion engines has been investigated since Otto and Diesel first developed their first principal approaches to modeling the thermodynamics of their engines. As the need for tight control over the combustion process has increased, due to government regulations of both harmful emissions and fuel economy, the engine control and diagnostic methods have been steady improving. Currently standards are met with conventional control techniques – such as speed versus load look up tables for the various electronic actuators. These tables are calibrated based on off-line simulation modeling and time intensive experimental testing. As the room for error shrinks with tightening regulations the need for real-time monitoring and adapting is becoming apparent. The direct monitoring of cylinder pressure in conjunction with thermodynamic modeling is still one of the best (and more cost effective) ways to do real-time engine diagnostics. The work presented here attempts to bridge the gap between typical off-line engine simulations and on-line real-time control strategies.

A computationally efficient model has been created that predicts the combustion trajectory (path through the equivalence ratio and temperature plane). The results are shown with the various combustion states highlighted, which indicates time progression during the combustion event. The sample test conditions shown highlight how a typical in-cylinder emission-control technique, exhaust gas recirculation, influences the combustion trajectory at different timings – i.e., showing the typical soot-NOx trade-off and the defeat of this trade-off when low temperature combustion (LTC) is obtained. Additionally, the traditional conceptual explanations for diesel combustion are explored relative to how they are illustrated in the combustion trajectory, especially the transition from pre-mixed to mixing controlled combustion. Understanding these behaviors in this context aids in explaining the different observations for the LTC modes.

Biography

Joshua A. Bittle will receive his Ph.D. in Mechanical Engineering from Texas A&M University in May 2014. He has worked in the Advanced Engine Research Laboratory at Texas A&M University since 2008 and has been involved in experimental diesel engine research investigating alternative fuels, advanced combustion modes, cyclic and cylinder variation, and dual fuel operation. He holds a B.S. degree (2008) from Oklahoma State University and a M.S. degree (2010) from Texas A&M University. His research interests all focus around the common goal of improving the energy conversion processes of the internal combustion engine. Specific areas include fundamental combustion studies, advanced combustion modes control and diagnostics, alternative fuels, and general engine characterization.

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