MichiganEngineering

ME Department Seminar Series

High-Efficiency, Ultra-Low Emission Combustion in a Compression Ignition Engine via Fuel Reactivity Control

Dr. Rolf Reitz
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Friday, November 6, 2009
10:30 am – 11:30 am
Room 1690 CSE

A dual-fuel concept is proposed to realize highly-efficient, premixed-charge compression ignition (PCCI) combustion with near zero levels of NOx and soot. In-cylinder fuel blending, with port fuel injection of gasoline and optimized direct injections of diesel fuel, is used to control combustion phasing and duration. The first part of the study used Computational Fluid Dynamics (CFD) modeling to suggest optimized fuel blends and EGR combinations. It was found that combustion phasing is easily controlled through optimized fuel reactivity. Furthermore, the results showed that the minimum fuel consumption could not be achieved using either neat diesel fuel or neat gasoline alone, and that the optimal fuel reactivity decreases with increasing load. Engine experiments were then conducted using a heavy-duty Caterpillar research diesel engine, and the experiments confirmed that optimal combustion can be achieved using blends of gasoline and diesel. Additionally, it was found that in-cylinder reactivity gradients extend the combustion duration and reduce the rate of pressure rise compared to single fuel operation. At a condition of interest for the present work (9 bar IMEP and 1300 rev/min), controlled combustion was achieved with NOx and soot levels significantly below the US EPA 2010 heavy-duty emission limits (without after-treatment) with net indicated thermal efficiency of 53% (net ISFC of 158 g/kW-hr), while maintaining low rates of pressure rise (<10 bar/deg). More information about the seminar topic is available at: http://www.engr.wisc.edu/news/headlines/2009/Aug03.html

Biography:

Dr. Reitz is Wisconsin Distinguished Professor of Mechanical Engineering at the University of Wisconsin-Madison. He is former director of the Engine Research Center and current director of the ERC's Diesel Emission Reduction Consortium. His research includes the development and experimental validation of modeling methodologies for internal combustion engines, and his models are used internationally by major automotive and engine companies.