

Clean Combustion within a Small-bore Optical Diesel Engine

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Small-bore High-Speed Direct Injection (HSDI) diesel engines are becoming attractive candidates for light duty vehicles due to their superior thermal efficiency and less greenhouse gas exhaust. New combustion modes, e.g. Homogeneous Charge Compression Ignition (HCCI) combustion, provide a unique approach for emission reduction. However, the application of HCCI combustion mode is limited in low load conditions. In this talk, a clean combustion mode, namely low temperature combustion, will be presented. Experimental investigations of low temperature combustion were carried out in an optically accessible diesel engine. The air-fuel mixing process, combustion, and late cycle soot were visualized through the application of advanced non-intrusive diagnostic techniques including Mie-scattering, Laser Induced Exciplex Fluorescence, natural flame luminosity imaging, time-resolved 2-D light extinction method, and so forth. The NO_x emission was measured in the exhaust pipe. It is shown that by controlling the in-cylinder air temperature around 800K-950K at the start of main injection low temperature combustion can be achieved with low soot and low NO_x emissions under an operation load up to 7 bar IMEP. Results of low temperature combustion with narrow angle direct injection technique will be demonstrated. Some examples of bio-diesel or biodiesel blends low temperature combustion will also be discussed. Results show that low temperature combustion with bio-diesel can simultaneously reduce soot and NO_x emissions. The mechanism for low temperature combustion is analyzed and addressed. Future research plans concerning sustainable and clean energy strategies will be outlined.

About the speaker

Tiegang Fang is a Ph.D. candidate in the Mechanical and Industrial Engineering Department at University of Illinois at Urbana-Champaign. He obtained his B.S. degree from the Automotive Engineering Department with a minor B.S. degree from the Computer Science and Technology Department at Tsinghua University, China. Before entering University of Illinois, he obtained his M.S. degree from the Mechanical and Aerospace Engineering at Rutgers University. He has been working on internal combustion engines since his undergraduate study. He is currently working on low temperature combustion within a state-of-the-art optical diesel engine using advanced laser diagnostic techniques. His research interests include internal combustion engines, combustion, laser diagnostics, energy and environment, spray and atomization, heat and mass transfer, and fluid mechanics.