Fuel Injection Spray Characterization Using Laser-Based Diagnostics

Relevance to the Automotive Industry:	For gasoline direct injection (GSI) and Diesel direct injection (DI) the fuel spray properties determine to a large extent the gas mixture at the time of ignition; hence also the combustion process in every cycle of an IC engine. State-of-the-art developments in modern common-rail or high pressure direct injection systems strive to model the spray properties as a function of the flow field of fuel in the injection nozzle. The aim is to improve predictive capabilities for overall engine performance as a step towards optimization in terms of fuel consumption and emissions reduction.	
Research Location:	TUD *Strömungsmechanik und Aerodynamik (SLA)*	VT *Advanced Experimental Thermofluid Engineering Research (AEThER) Laboratory*
Homepage (Engl.):	http://www.sla.tu-darmstadt.de/willkommen.eng.php	www.me.vt.edu/aether
Faculty Mentor:	Prof. Dr.-Ing. Cam Tropea	Prof. Pavlos Vlachos, Ph.D.
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Project Description: Jun 9 - Aug 1, 2008; (8 weeks, 40h/week)	At the FG-SLA in Darmstadt an experimental rig is currently in use in which model fuel injection nozzles and their atomization properties can be measured in detail. The nozzles are fabricated out of acrylic glass and the operating liquid (oil) is refracted index matched to this glass through exact temperature control. This allows laser Doppler measurements to be performed in the injection nozzles to characterize the flow field and phase Doppler measurements for measurement of any cavitation or gas bubbles. In the proposed project emphasis is to be placed on characterizing the resulting spray using both the Phase Doppler technique (PD) and interferometric imaging (IPI). These laser-based diagnostic techniques allow the size and velocity of individual droplets to be captured. The PD technique is a point measurement technique whereas the IPI technique provides information over an entire region. Specifically the research program will be as follows: At TUD the student will work closely with the graduate mentor to carry out PD and IPI measurements in the spray rig. In this way he will become intimately familiar with this techniques and their achievable accuracy. He will then use the same techniques to measure a transportable atomization device which can then be operated after returning to VT. At VT the student will measure the same atomization device using a high-resolution digital particle image velocimeter. The aim in this part of the research is to test existing particle sizing algorithms for the DPIV device and to verify them against the data obtained using the PD data.	
Necessary Skills/ Knowledge:	• Microsoft Windows (operating system)	
Desirable Skills/ Knowledge:	• some laboratory experience	
Additional Online Resource:		

NSF REU Students must have completed at least two semesters of engineering studies prior to the proposed summer research, and they must have at least one semester remaining before they can earn their BS in Engineering.