Influence of flow on PCCI combustion in a Heavy-Duty engine


Introduction
Premixed Charged Compression Ignition (PCCI) uses stratified regions to decrease the rate of heat release (RoHR). A very aggressive RoHR is a serious issue when applying Homogeneous Charged Compression Ignition (HCCI) at higher loads. In this project the influence of charge stratification on PCCI combustion is investigated by measuring in-cylinder velocities with and without spray injection. Stratifying charge both in temperature and in concentration will be done in the future using multiple injections.

One-cylinder optically accessible engine setup

Time Resolved PIV
Time Resolved PIV is used to visualize the flow in one cycle.
• Vision research Phantom V7.1 high speed camera
• Edgewave IS8II-DE high speed laser
• Lavision high speed controller + Davis

Turbulent kinetic energy
From the time resolved measurements the turbulent kinetic energy is determined using:

\[
TKE \equiv \frac{1}{N} \sum_{i=1}^{N} \left( \frac{(U_{x,i} - \overline{U}_x)^2 + (U_{y,i} - \overline{U}_y)^2}{m^2/s^2} \right)
\]

Conclusions
• TKE increases as function of rotational speed
• TKE increases as function of CAD, but decreases near TDC, turbulence dampens out
• TKE is slightly influenced by chosen interrogation window size
• In-cylinder flow is not significantly influenced by 500 bar spray injection
• Entrainment of air into spray is clearly visualized
• TKE level is lower in the plane close to cylinderhead (h=2mm)

Outlook
• Influence of multiple n-heptane DI injections on turbulence level and emissions.
• Measurement of temperature stratification by using tracer LIF using toluene

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