Comparison of Particulate Emissions from Multiple Combustion Modes

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Motivation
The objective of the project is to compare the particulate emissions from a wide range of conventional and advanced combustion strategies in a common engine platform. The combustion modes include conventional diesel (CDC), RCCI, HCCI, diesel low-temperature combustion (DLTC) and two gasoline direct-injection compression-ignition (GDICI) strategies. The use of a single engine will, to as high a degree as possible, eliminate variations in the background particulate level (for example due to the lubricant) and sample-handling procedure. The current focus is the measurement of the particle size distribution using a scanning mobility particle sizer (SMPS).

Experimental Setup

Fuel Delivery Methods for Combustion Strategies

Revised GCI LI Strategy
- High NOx emissions were found for original GCI LI strategy
- Parameters (intake conditions, EGR %, etc.) were adjusted to achieve better emissions performance

Revised GCI LI Operation generally show higher concentrations for accumulation mode particles compared to original GCI LI strategy

New Dilution System
New dilution system with Volatile Particle Remover (VPR) between stages
- Can utilize different VRPs - evaporation tube, catalytic stripper, etc.
- Multiple potential sampling points during dilution process
- Goal is to enable well defined solid-particle PSD measurements

Single/multi-cylinder engine comparison
Collaboration with Argonne National Lab (ANL) to collect PSD data on a multi-cylinder engine (MCE) platform
- Similarities: same engine geometry (cylinder, piston, injector, etc.), similar sampling/measuring equipment
- Differences: MCE vs. SCE, fuel, compression ratio, engine intake pressure control, sampling position and temperature

Example: GCI LI Mode 2 (1490 rpm/ 4.2 bar IMEP)
- PSD results do not match in magnitude, but are similar in shape
- Further investigation and calibration of equipment is needed

Future Work
- Further MCE vs. SCE Comparison
- Implement the new dilution system
- Collect loaded filter samples and perform filter testing