Thermal analysis for high efficiency engine gas-exchange systems

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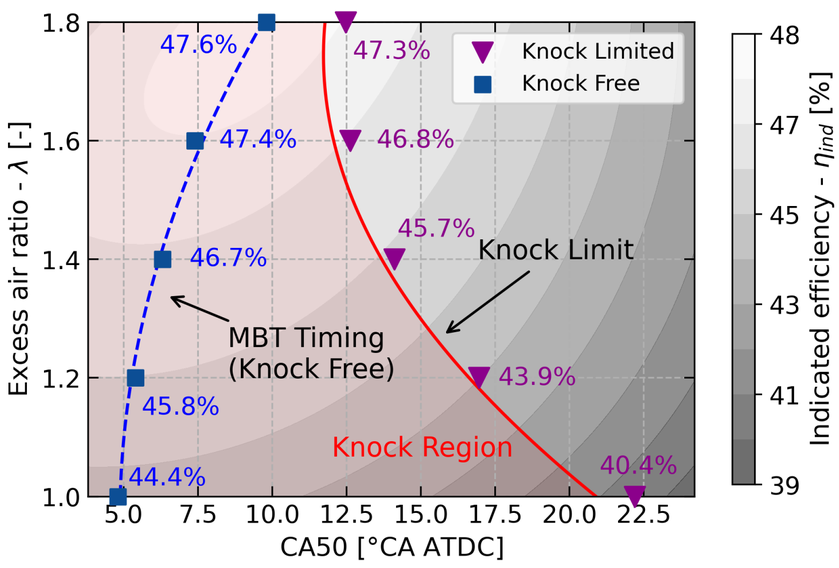
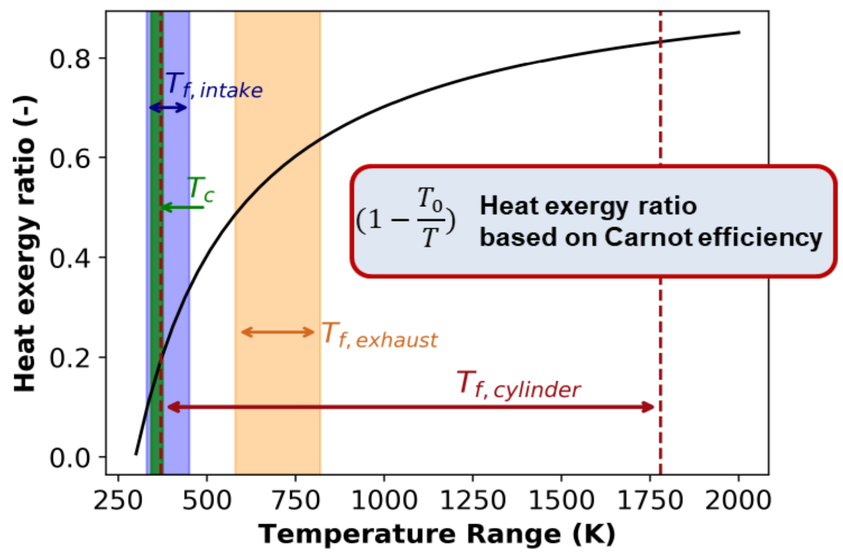
This study is concentrated on thermal analyses of internal combustion engines operation, with special interests on gas exchange, fuels and in-cylinder processes. Current work involves the following topics: (1) aerothermodynamics analysis on gas-exchange systems; (2) exhaust pulses characterization based on fast measurement techniques; (3) energy and exergy assessments of the combustion losses.

Exergy losses in different engine systems:

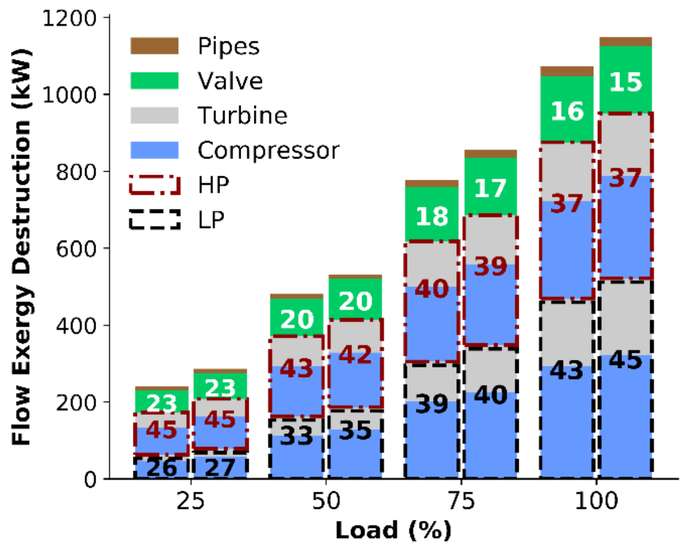
(a) Diluted combustion efficiency comparison



(b) Heat exergy ratio & exergy Loss due to heat transfer



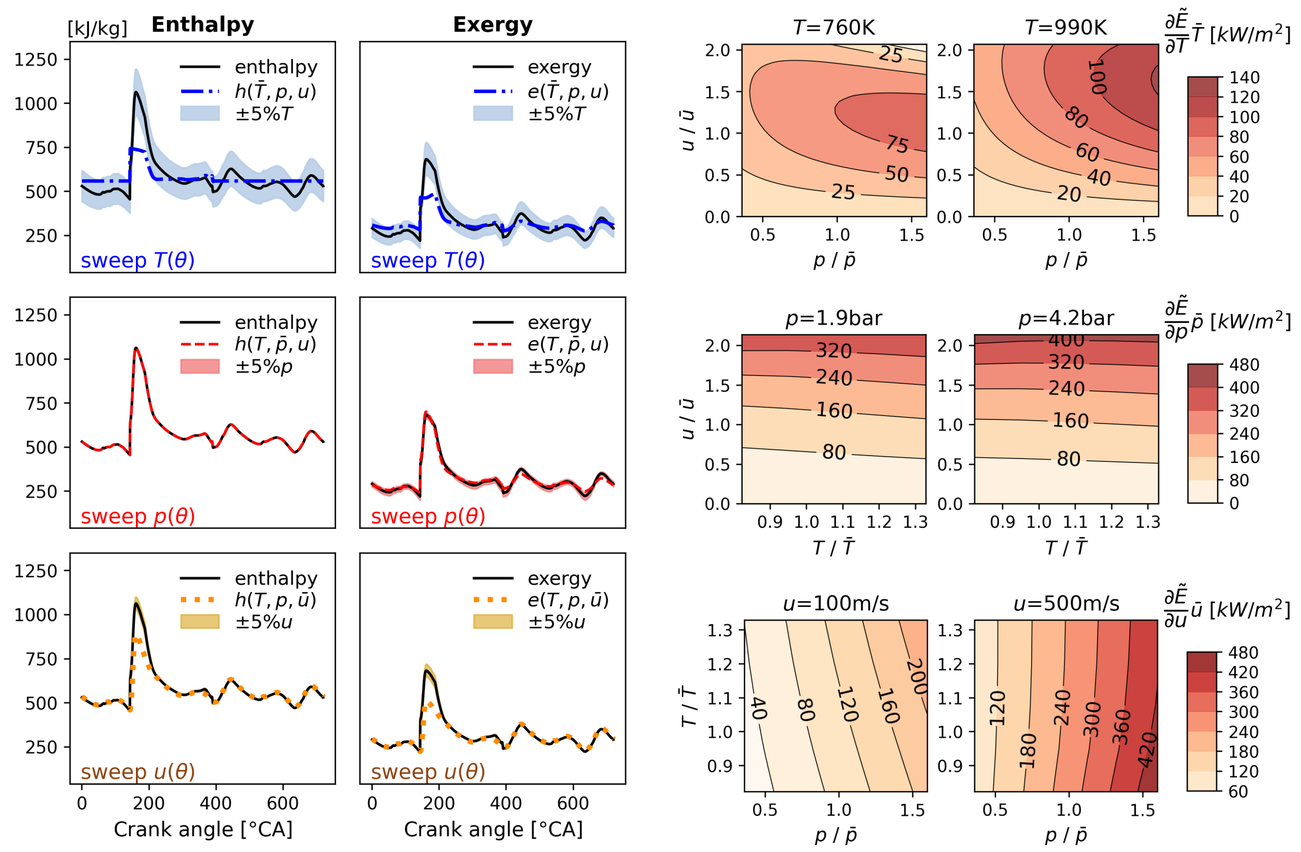
(c) Flow exergy destruction in a two-stage turbocharging system for a marine engine



Research activities (2018.11-2022.05)

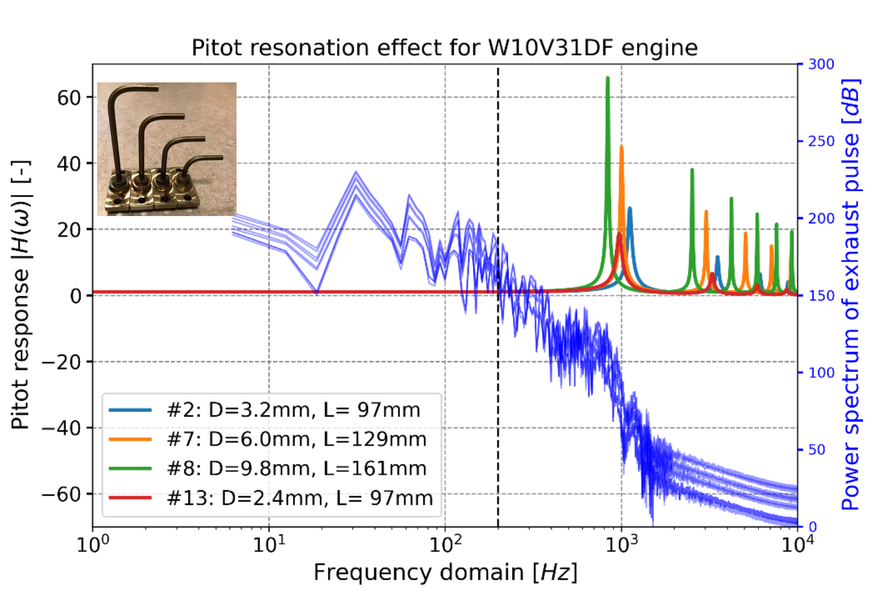
- Aerothermodynamics analysis of a marine engine gas-exchange system (2019);
- Sensitivity analysis of flow parameters for measuring the flow energy and exergy of exhaust pulsations (2020);
- Analysis for diluted combustion for a heavy-duty engine based on a semi-predictive spark-ignited model (2020);
- Pitot-tube-based technique to measure the velocity of exhaust pulsating flow (2020-21);
- Exhaust pulsating measurement campaigns for both truck and marine engines (2021-22).

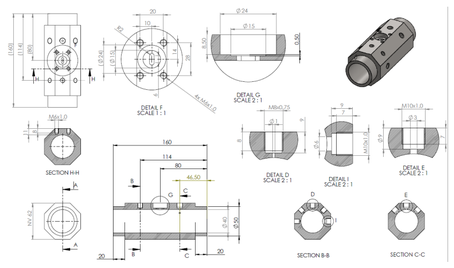
Sensitivity analysis for measuring exhaust pulsating energy rates:

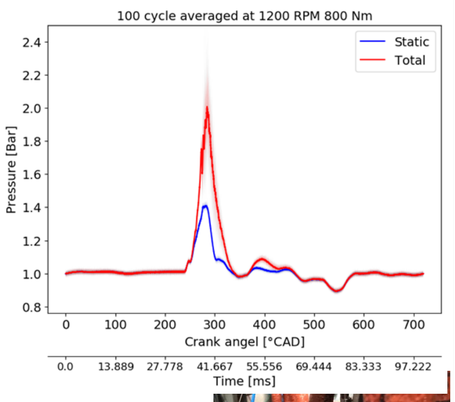


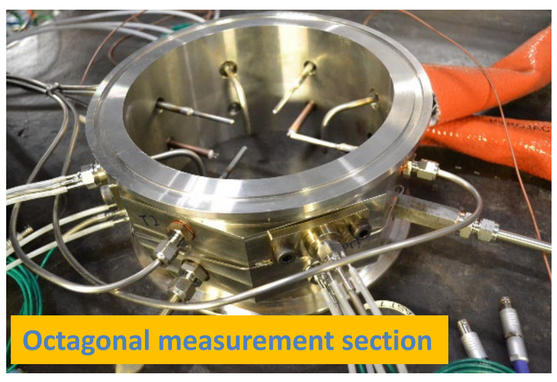
Sensitivity analysis of flow pressure, temperature, and velocity of truck engine pulsations located at the exhaust manifold inlet with the operating condition 1300rpm/17.8nIMEP.

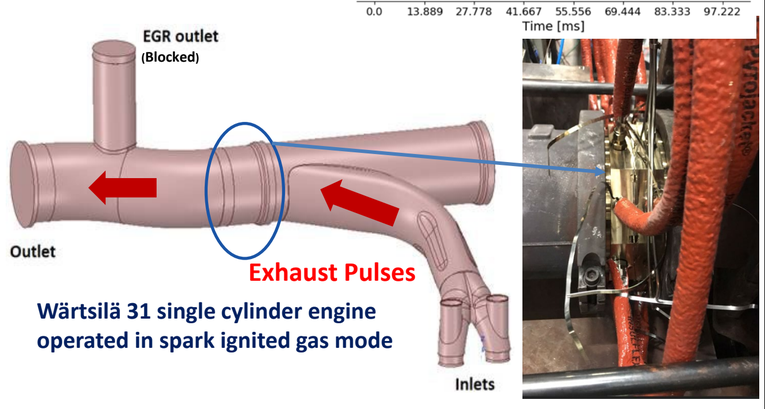
Flow velocity measuring of exhaust pulses by pitot-tube:











Pitot-tube-based measurement is implemented to capture the crank-angle-based flow velocity of engine exhaust pulsations. The corresponding calibration and on-engine test campaigns are conducted in both truck and marine engines.

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