Vehicle Propulsion Information Integration

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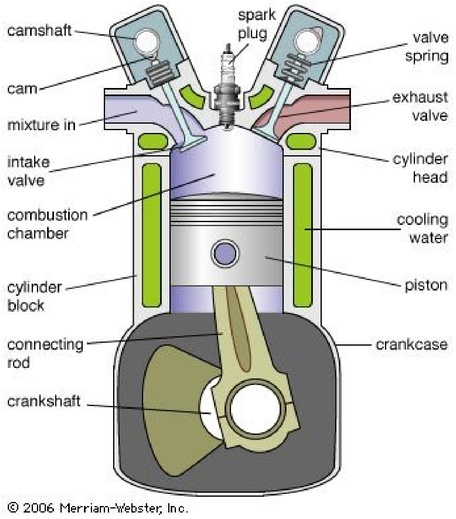
Problem outline

Control of the combustion process is very important since it directly influences both emissions and efficiency.

Predictive models for heat release (mixing, turbulence etc) are not yet reliable enough and certainly not fast enough for control. Instead simplified, physically motivated, models tuned to measurement data may be used.



The goal is to have a systematic method that answers the important questions

- How much air have we inducted into the engine?
- How much residual gases are left since the last cycle?
- How was the fuels chemical energy converted to thermal energy and work?
- What is the position and speed of combustion?

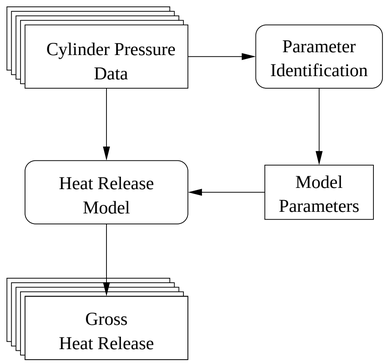
Project Overview

Today's vehicles are under strict legislative requirements regarding emissions and thus need proper control and diagnosis functionality to secure operation within the prescribed limits.

Interesting properties for control are not always directly measurable or sensors may be far to expensive or unreliable to use directly.

A key characteristics is the interplay between modeling and information fusion, using information from in-vehicle sensors, databases, as well as communicated information from other vehicles and infrastructure.

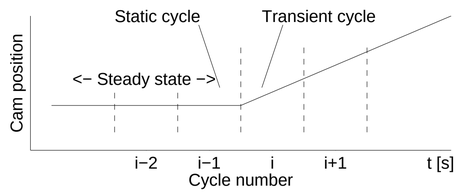
Example - Heat release analysis



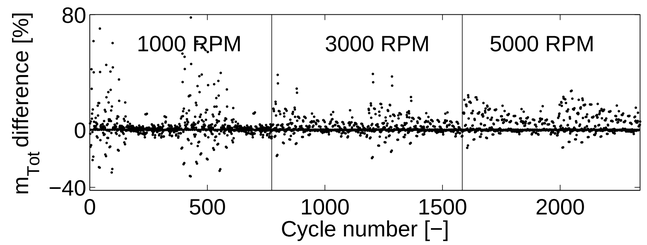
In a heat release analysis process a thermodynamic model is necessary for data extraction. A first law analysis gives an ODE which can be used to identify parameters for each combustion cycle. The process is time consuming and requires much data. A systematic approach is therefore essential.

A prediction error method with regularization is used in [1] to automatically find a tradeoff between prior knowledge such as geometries and gas properties and estimated parameters.

Example - Estimation of residual mass fraction



During transients in Valve Timing for a CVCP engine different models are more or less sensitive to the transient effects. In [2] it has been shown that the actual air charge may differ as much as 80% during the transient and that some methods performs equally well during the transient while other, otherwise better methods, performs worse during the transient. It may therefore be necessary to use different methods of estimation in different situations depending on driving conditions.



Publications

[1] Markus Klein. *Single-Zone Cylinder Pressure Modeling and Estimation for Heat Release Analysis of SI Engines*. PhD thesis, Linköpings universitet, November 2007.

[2] Per Öberg and Lars Eriksson. Control oriented gas exchange models for CVCP engines and their transient sensitivity. *Oil & Gas Science and Technology - Rev. IFP*, 62(4):573–584, 2007.