CMCL

# Driving Sustainable Commercial Transportation:

# Digital Workflows for Natural Gas Engine Applications

## The Challenge

Developing a high-fidelity digital workflow to accurately evaluate the emissions performance of a Natural Gas-fuelled Spark Ignition (SI) engine for long-haul on-road heavy-duty commercial transport.

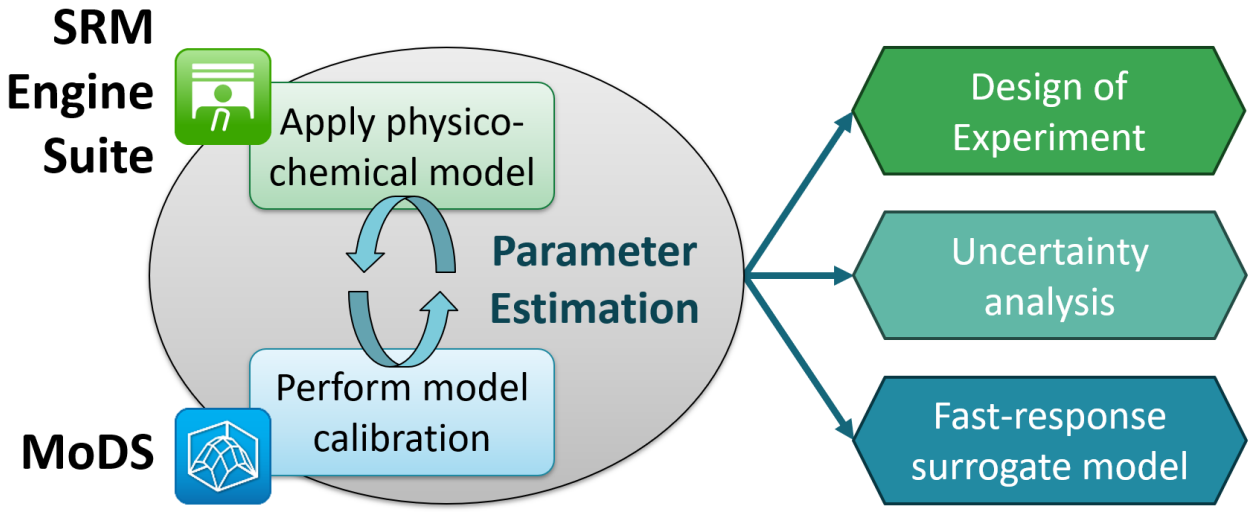
## Our Solution

Deploy the high-fidelity physico-chemical modelling capabilities of CMCL's MoDS-SRM Engine Suite workflow to construct a detailed physical model and a fast-response surrogate model for emissions analysis.

## Key Results

Successful evaluation of engine combustion characteristics, pressure and emissions under various operating conditions.

The validated models form the foundation for further optimisation of design and control strategies for the engine application.





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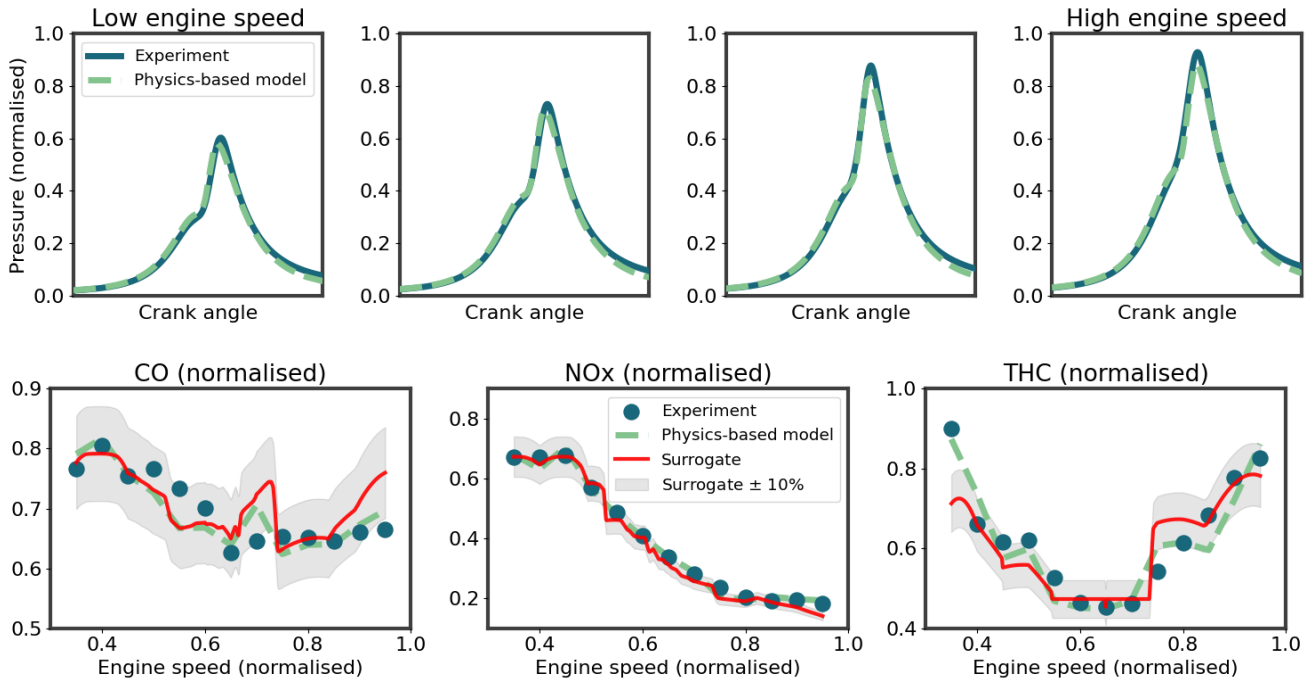
# OVERVIEW

Natural gas engines, due to their efficiency and resilience, are becoming increasingly important in long-haul heavy-duty truck applications. Detailed, accurate and efficient digital workflows for modelling these engines are crucial to maximise their performance and energy output while minimising emissions. In this use case, we deploy the MoDS-SRM Engine Suite workflow to create a high-fidelity physico-chemical model of a natural gas engine. This digital engineering workflow allows us to predict the engine's combustion characteristics, in-cylinder pressure, and emissions under various operating conditions. The digital workflow generates a surrogate model based on the validated detailed model, which can contribute to reducing not only the computational expense but also the number of experimental/test-cell data points.

Our results underscore the strength of our digital engineering approach in creating robust and reliable engine models. This capability is key in enhancing the performance and resilience of natural gas engines for efficient long-haul heavy-duty truck applications, thus facilitating the development of more sustainable and cleaner transportation solutions.




## What we can offer:

- Physics-based **predictive combustion** and emissions simulations with detailed chemical kinetics.
- Support for full model development cycle, including **parameter estimation**, **uncertainty analysis** and **multi-objective optimisation**.
- Generation of **fast-response surrogate** model for integration with full-scale system simulations.

## We would require:

- Engine dimensions
- Fuel specifications
- Engine operating conditions
- Pressure characteristics
- Emissions measurement

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