



Clean Propulsion Technologies

Our goal: a clean, green, ultra-efficient marine engine with RCCI combustion

Process

The test cell is at the University of Vaasa's VEBIC engine laboratory. It has a Wärtsilä® W4L20 marine diesel engine, that is modified to accept gaseous and liquid fuels using low-temperature RCCI combustion.

Hardware modifications include engine components such as cylinder head and liner, pistons, multiduct, fuel injectors and exhaust piping. Additions include a fuel system for gaseous fuels and pilot fuel, electro-hydraulic valve actuator (EHVA) and updates for data acquisition system and sensors.

Engine control and safety functions are broadened to suit gaseous fuels. Engine control is more challenging with different combustion phenomena and more complex systems.

The data acquisition system (DAQ) is updated to handle high-frequency signals and operate in real-time during engine measurements. Emissions analysis is added to the DAQ system.

The design of experiment (DoE) tool is used to plan engine measurements. The data are analysed in real-time during engine measurements, with a new post-processing capability.

References

Upatnieks, C. J. Mueller, and G. C. Martin, 2005, "The influence of charge-gas dilution and temperature on DI diesel combustion processes using a short-ignition-delay, oxygenated fuel", SAE 2005-01-2088.

Speedgoat real-time target machine, brochure, speedgoat.com

Cambustion HFR500 Fast FID, brochure, cambustion.com

As the marine and off-road sectors seek cleaner, greener energy sources, the goal of the Clean Propulsion Technologies (CPT) consortium is to establish the Finnish powertrain industry as a global technology leader by creating a common vision and sustainable business solutions.

This involves developing novel combustion concepts and advanced aftertreatment systems. This poster describes our work to demonstrate viable low-temperature reactivity controlled compression ignition (RCCI) in a mid-speed, large-bore marine engine.

What is RCCI?

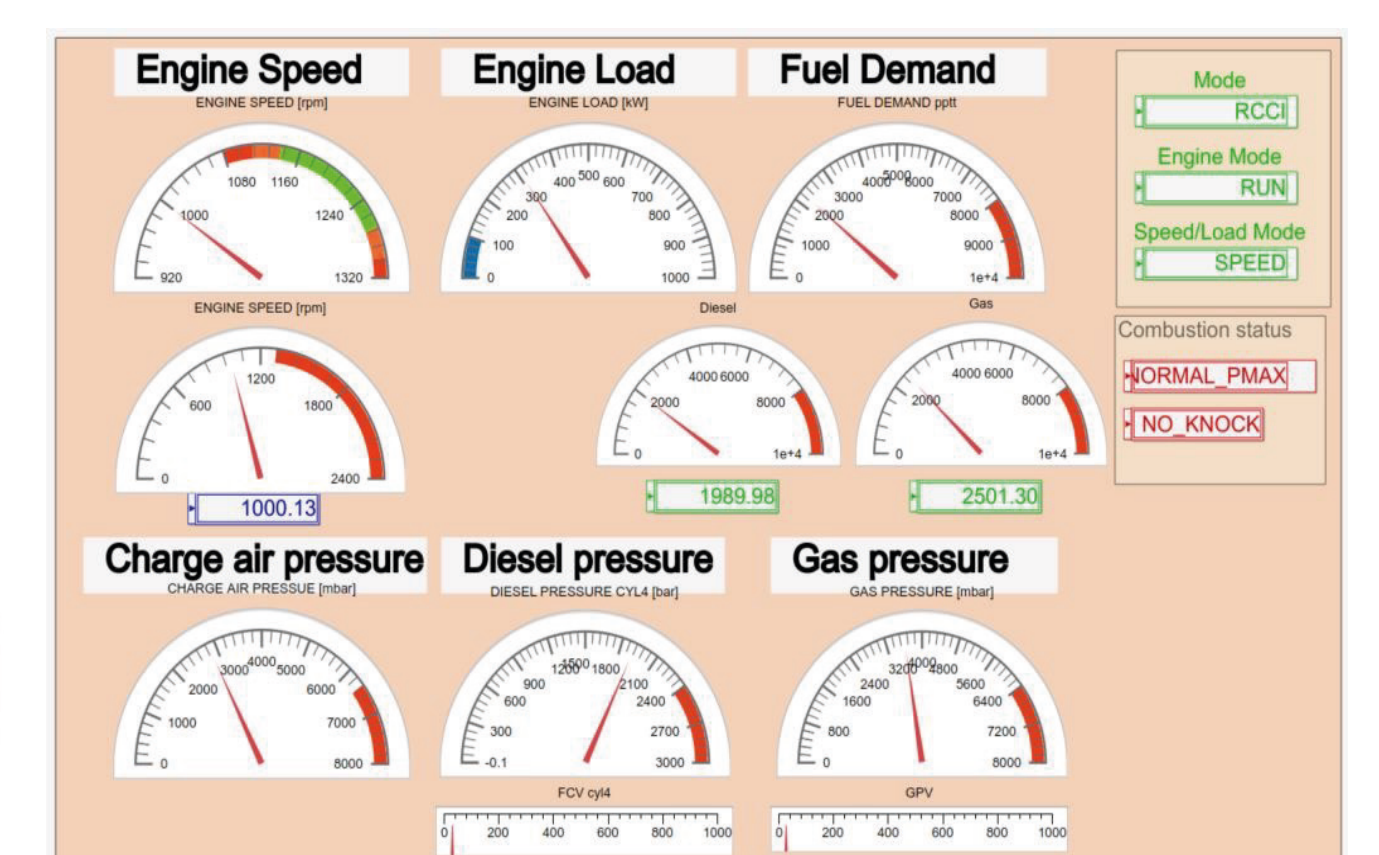
- ▶ Novel flexi-fuel combustion strategy
- ▶ Controlled by adjusting fuel reactivity, and with advanced thermal management
- ▶ Aims to elevate engine performance above current state of the art and cut emissions to near-zero
- ▶ Calibration and control of RCCI is hugely challenging

Benefits of RCCI?

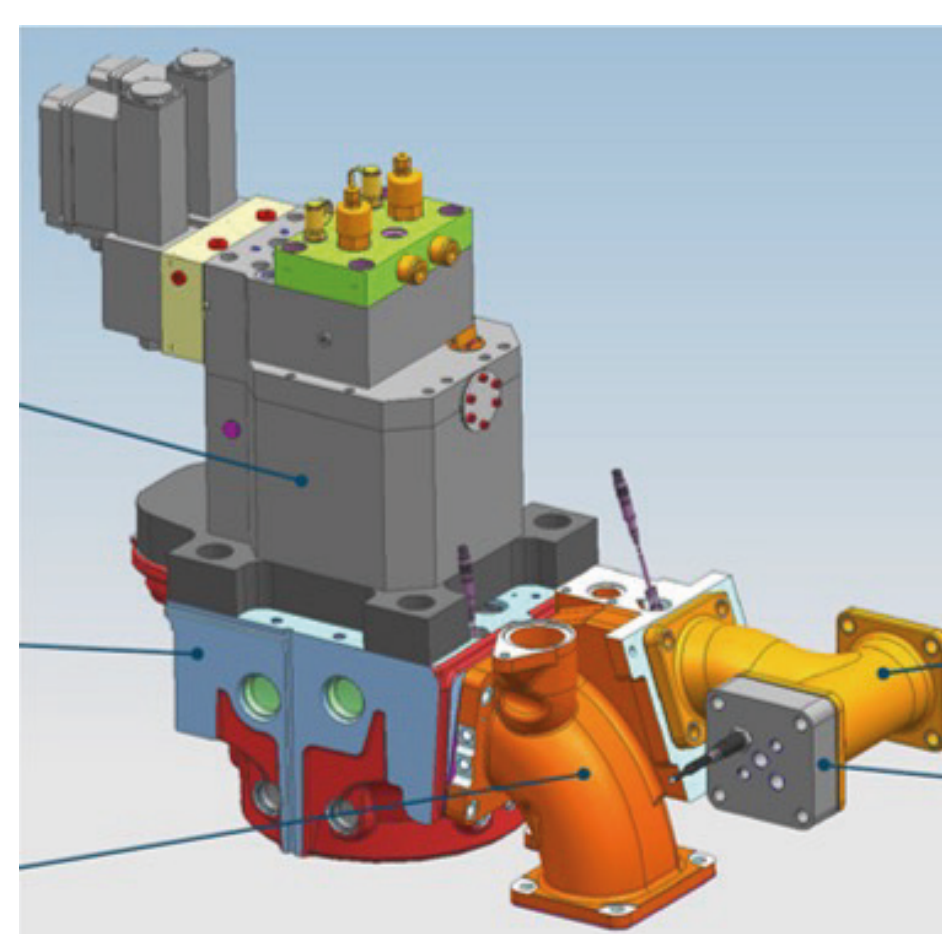
- ▶ Better efficiency: up to 55%
- ▶ Ultra-low NOx and PM emissions (Euro 6 level)
- ▶ Flexible operation over a wide range of engine operating conditions
- ▶ Enables efficient use of clean alternative fuels (biogas/methanol/HVO etc.)



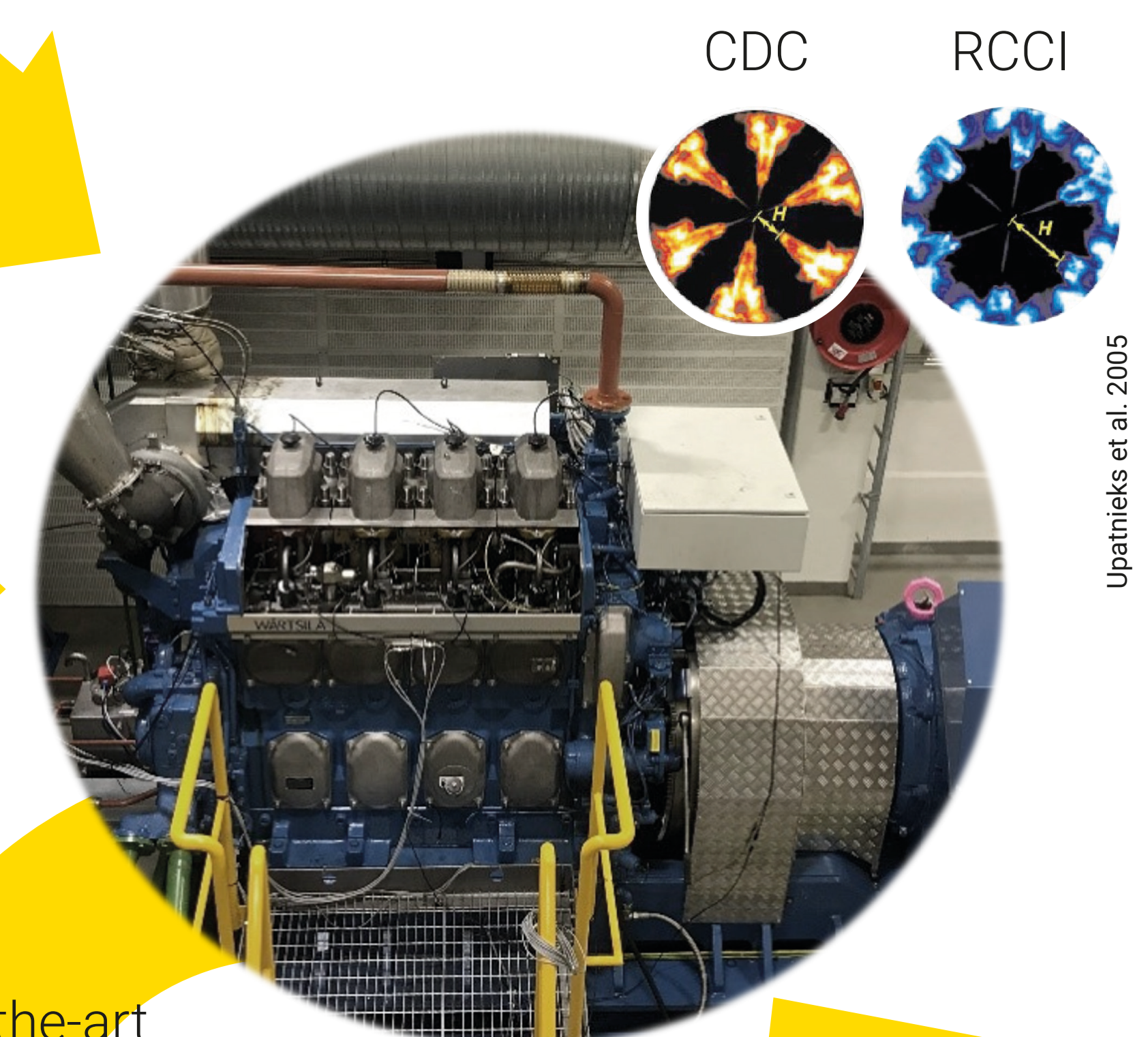
Speedgoat.com



Sophisticated closed-loop control



Advanced hardware



Upatnieks et al., 2005

State-of-the-art sensors and data processing

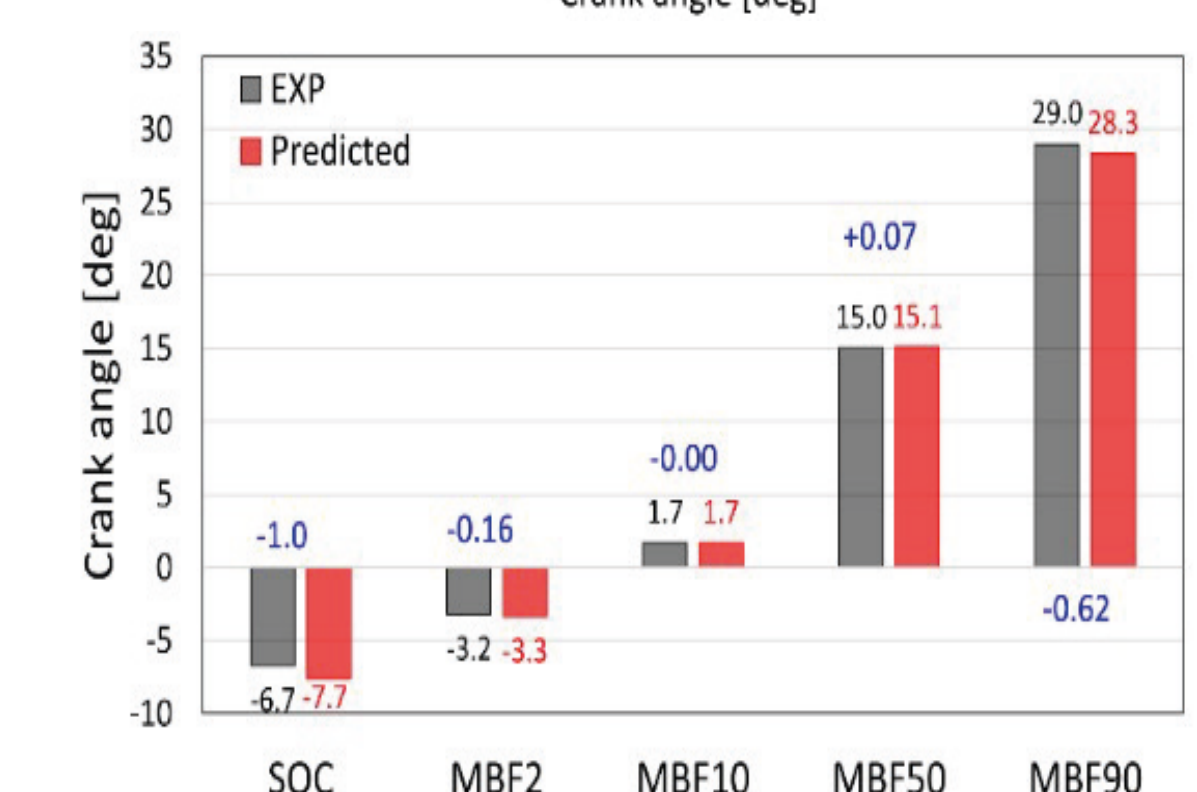
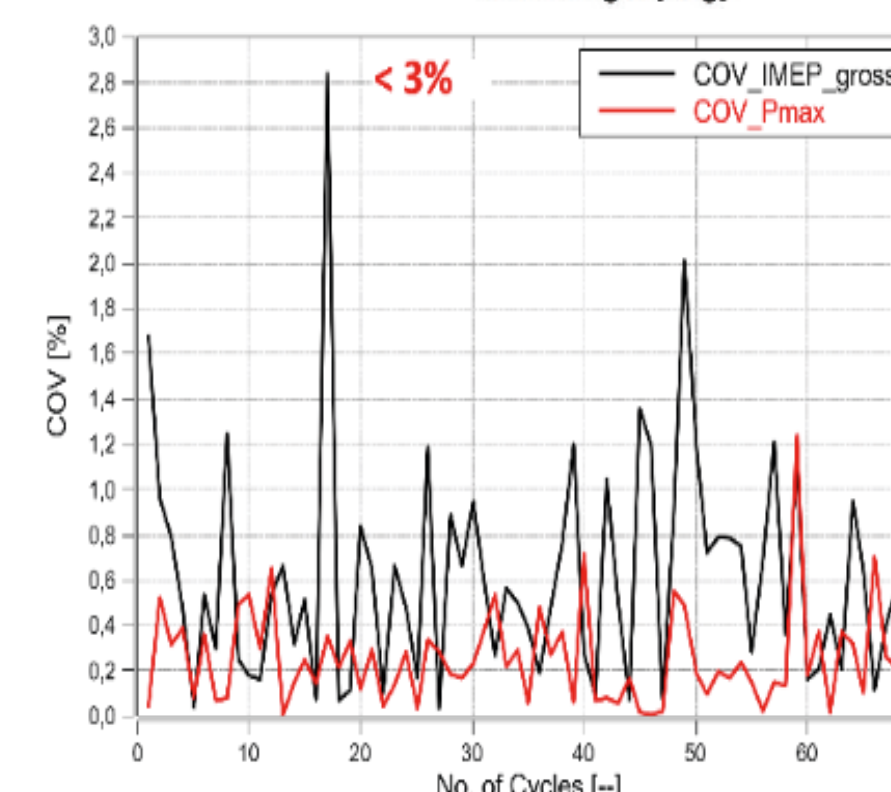
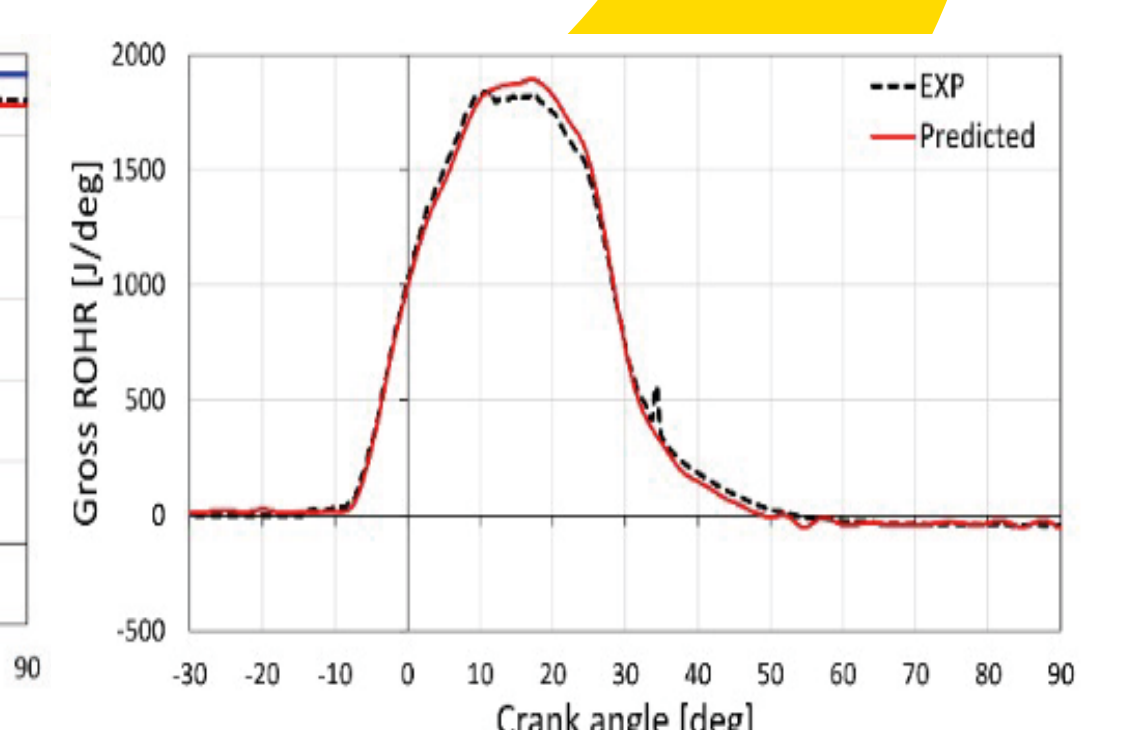
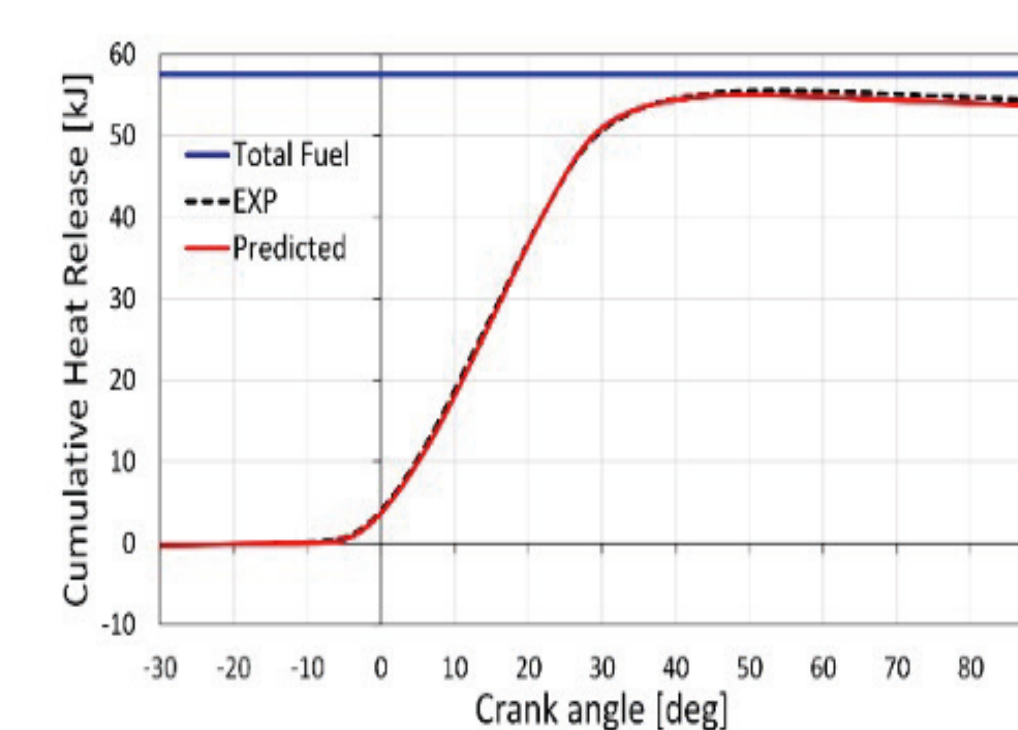
Model-based development



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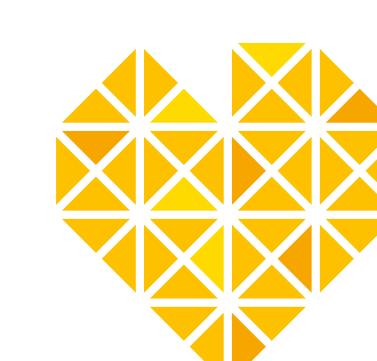
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