virtual engine mapping of Tier IV HD diesel engines for non-road applications

An increasing scope of potential design options mean that engine developer must consider the performance/contribution of multiple technologies over the full engine speed-load map. This is now a multi-dimensional challenge, requiring significant experimental investment, thus predictive combustion and emissions simulators are a key tool to isolating and understanding the interdependencies.

THE CHALLENGE

To calibrate the srm engine suite against a reduced data set and apply these parameters to extrapolate over the whole engine load-speed map of a state-of-the-art diesel engine.

COMBUSTION & EMISSIONS COMPARISON

Below are the resulting predicted heat release rates and in-cylinder pressure profiles, in these cases performance is to well within experimental cycle-to-cycle and measurement uncertainties.
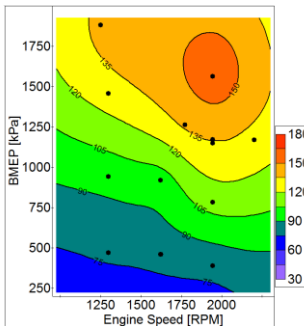
The results of the simulation are presented on the right-hand-side. In general, the whole map was simulated well for combustion characteristics and NOx emissions. In particular picking out the trends in EGR, fuel loading and injection pressures.
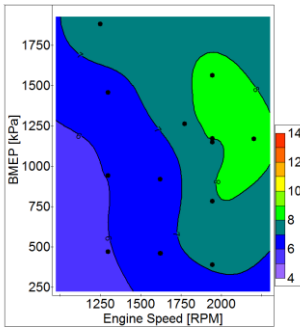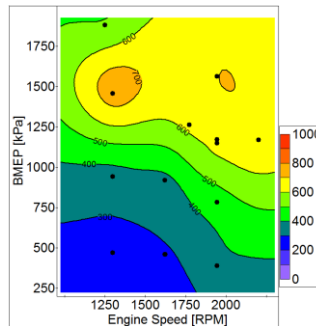

Ignition delay time (10%HR-SOI) [CAD]
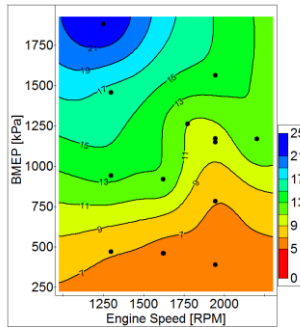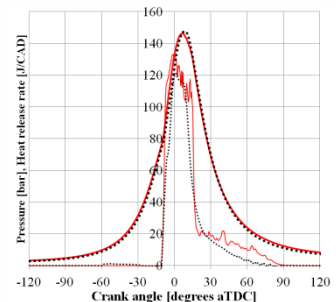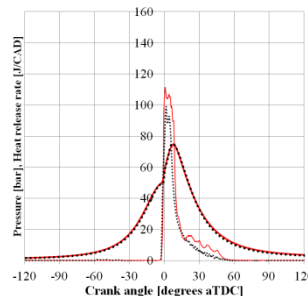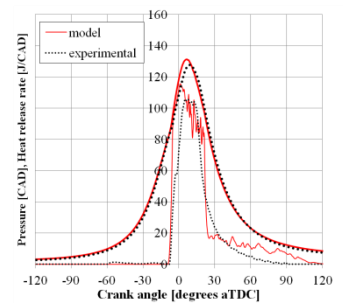

50%HR [CAD]

Peak pressure [bar]

NOx emissions [ppm]

More details of this analysis are published in the SAE paper 2013-01-0308.

SUMMARY

- A heavy duty CIDI engine was simulated
- The srm engine suite was calibrated against a single engine operating point
- The performance of the model was assessed across the whole engine map
- The model was considered robust for combustion characteristics and emissions