

IC Engine Simulation via Cloud

Applying the SRM Engine Suite to Dual-Fuel IC Engines run on the CloudSME Platform



*Simulation for
manufacturing & engineering*

Virtual engineering combining physico-chemical and advanced statistical algorithms provides a cost-effective means to optimise the design and integration of technologies aimed at the development of modern, low-emission energy-conversion powertrains for vehicular and stationary power generation applications.

THE CHALLENGE

Simulation of practical fuels and IC engines through Software-as-a-Service (SaaS)

THE SOLUTION

Using the SRM Engine Suite software via a cloud-based simulation platform

THE RESULTS

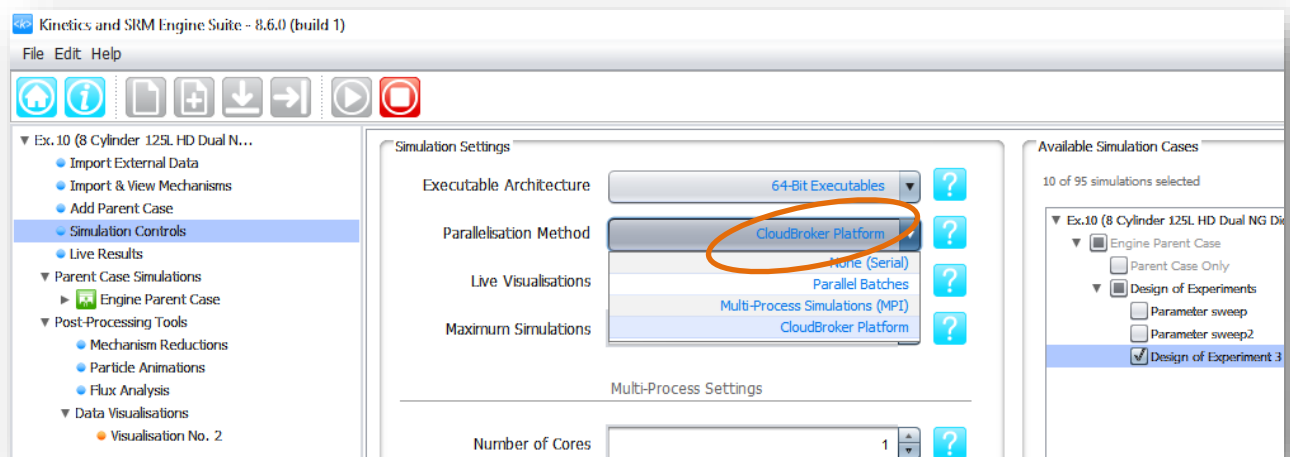
- SRM Engine Suite software implemented and tested on multiple clouds through the CloudSME Platform
- The CloudSME Platform used to demonstrate the simulation of a dual-fuelled (natural gas +diesel) IC engine
- Sensitivity of combustion characteristics to operating parameter sweeps in fuel-substitution ratio, intake manifold temperatures/pressures

Deploying robust virtual engineering toolkits for powertrain design is imperative when the degrees of freedom of the IC engine are further increased on account of the physical and chemical characteristics of a single or multiple fuels used. Dual-fuel engines running with natural gas and pilot quantities of diesel offer a distinct advantage in terms of lower NO_x and soot emissions in addition to the lower overall CO_2 footprint (~25% reduction in CO_2 at a 90% fuel substitution ratio), as compared to a baseline diesel fuelled compression ignition (CI) engine.

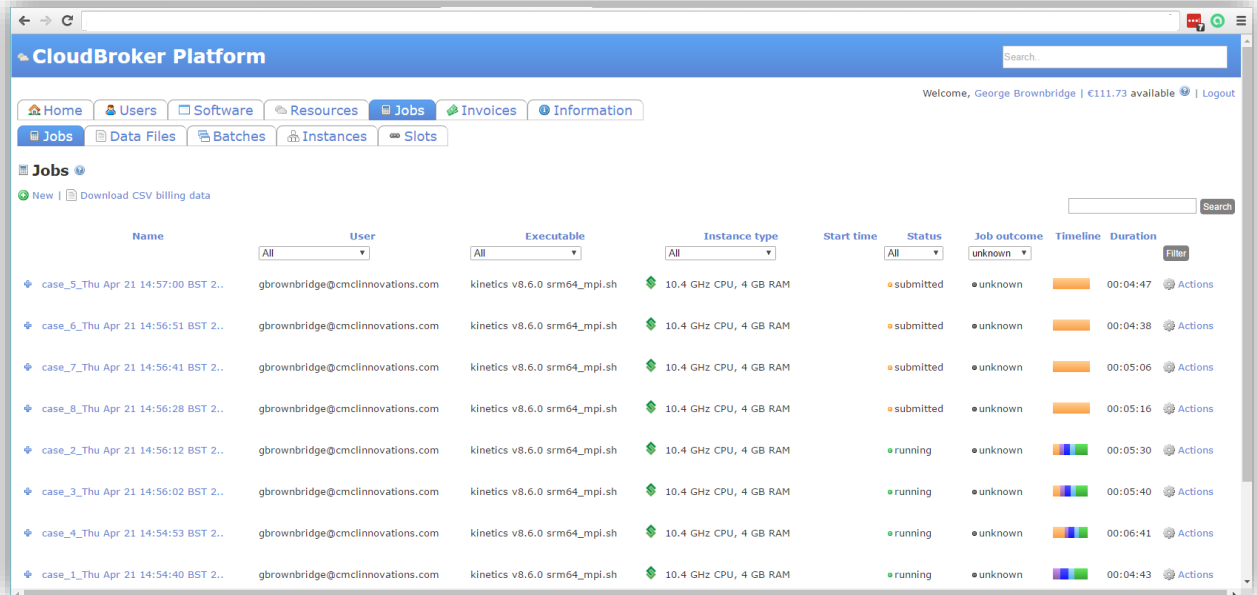
The multivariate nature of the technical problem combined with the need to run multiple model evaluations either to:

- capture sufficient physics, for example, multiple engine cycles to account for cycle-to-cycle effects or;
 - undertake design of experiments (DoE) and parametric sweeps over a large number of operating parameter space,
- can render the overall CPU time of the order of days.

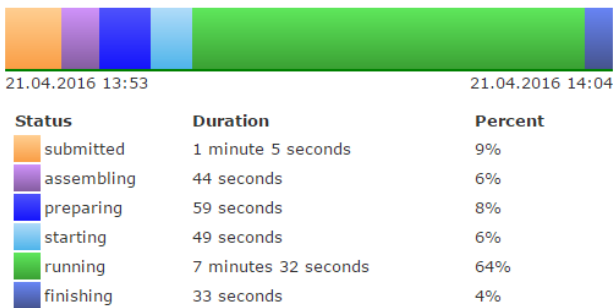
CMCL Innovations offers the SRM Engine Suite toolkit, enabling its users to perform the two aforementioned tasks efficiently. While the simulators is available as a desktop software, the CloudSME Platform has provided CMCL Innovations with the opportunity to test and demonstrate its toolkits to be run in a Software-as-a-Service (SaaS) operating mode.



User Story



SRM Engine Suite simulation runs (Jobs) viewed via the CloudSME Platform



Above: Resource status for individual Jobs

WORKFLOW

- Select the "CloudBroker Platform" option from the SRM Engine Suite GUI
- Set-up the multiple simulation runs (Jobs) in the form of parent or child cases, DoE, parametric sweeps etc. using the SRM Engine Suite GUI
- Display of the multiple simulation runs (Jobs) available via the CloudSME platform
- Track the progress of the individual simulation runs (Jobs) and the resource usage status via the CloudSME platform.

Parametric sweeps

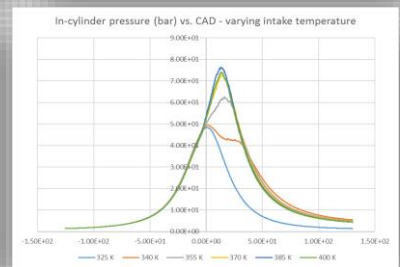
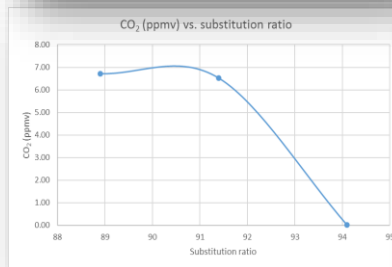
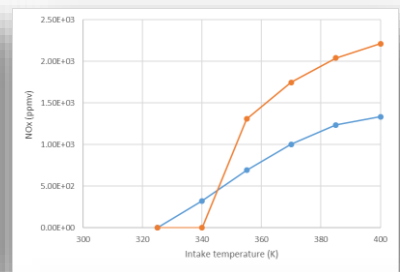
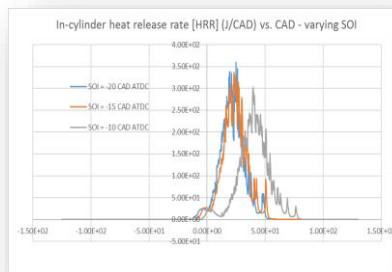
Parametric sweeps of the validated SRM Engine Suite were performed across the full range of substitution ratios, EGR rates, boost pressures, intake temperatures, start of injection (SOI), etc.

APPLICATION AREAS

- Dual-fuel engines
- Diesel engines
- Parametric sweeps
- Substitution ratio
- In-cylinder pressure and HRR
- Emissions simulations

PRODUCTS USED

- SRM Engine Suite
- CloudSME Platform
- Dual-fuel chemical model



Above: Influence of operating conditions on combustion and emissions

Simulation end-users: G-volution Plc and CMCL Innovations

