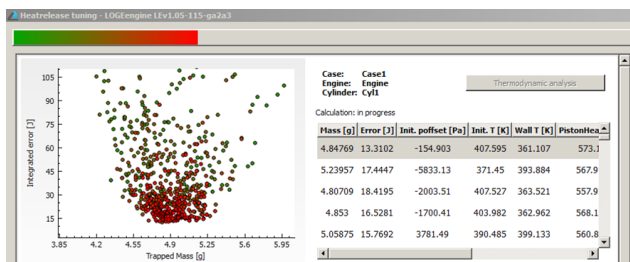# LOGEengine

The simulation tool specifically designed for analysis and development of Internal Combustion Engines (ICE).

LOGEengine is a simulation tool for the engine development and prototyping process. Thanks to the employment of advanced chemical and physical models for both premixed and non-premixed combustion, LOGEengine is capable of predictive engine performance and emission analyses under any combustion mode.
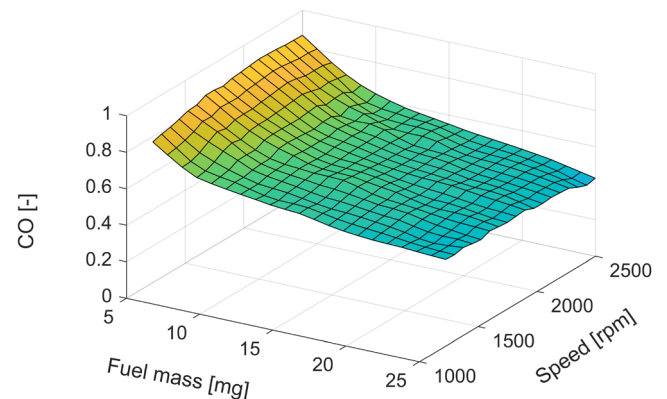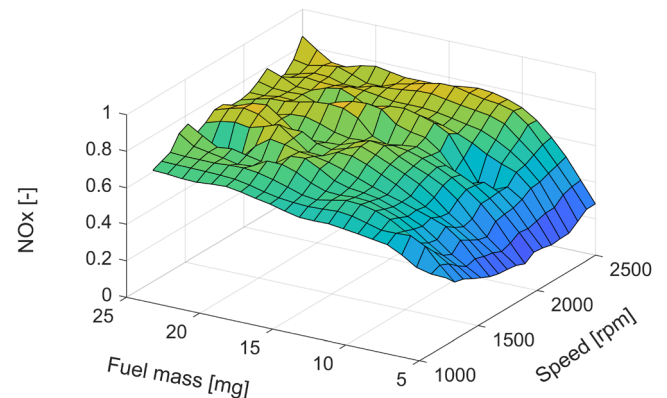
LOGEengine framework accounts for

- Mixture inhomogeneity in the combustion chamber
- Turbulence chemistry interaction
- Detailed chemistry for combustion and emissions
- Advanced mixture formation and combustion processes
- Heat transfer to the cylinder walls
- Real gas effects
- Complete engine cycle simulations

Using a genetic algorithm (GA), LOGEengine can identify the ideal dataset for compression ratio, initial temperature, fuel/air mass, EGR rate, wall temperature and pressure offset for any set of experimental data. Once experimental data has been analysed, the calculated setup can either be used as a starting point for 3-D CFD simulations or for engine parameter mapping where LOGEengine seeks out the most advantageous fuel injection or spark timings for optimal engine operation.
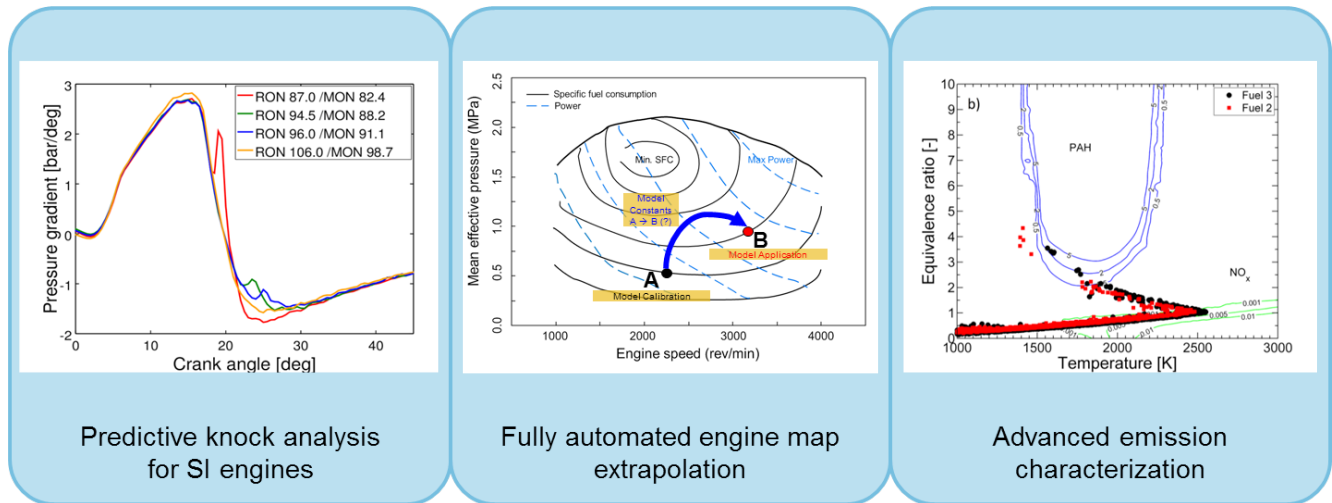

Nitrogen Oxides (top) and Carbon monoxide (bottom) emissions at Exhaust Valve Opening (EVO) calculated for a wide range of speed-load conditions using the engine mapping module in LOGEengine.

Experimental data assessment and initial conditions optimization via thermodynamic analysis using genetic algorithm.

Advanced features

- Engine parameters variation such as: sensitivity to spark timing, fuel injection strategy etc.
- Multi-cylinder analysis
- Full engine map extrapolation based on experimental data from few operating points
- Real time engine simulation and hardware in the loop capability for Diesel applications

Predictive ICE combustion and emission simulation using detailed chemistry.

What are the unique capabilities of LOGEengine?

Predictive knock analysis for SI engines

Fully automated engine map extrapolation

Advanced emission characterization

LOGEengine's backbone is the 0-D Stochastic Reactor Model (SRM) framework where inhomogeneity of the in-cylinder mixture can be taken into account. Complex physical and chemical processes such as mixture formation, turbulent flame propagation or soot formation, are modelled using state of the art methodologies:

- k/epsilon based mixing time model
- Monte Carlo based flame propagation model
- Euclidean Minimum Spanning Tree (EMST) based approach for modelling of particle interaction
- Tabulated chemistry based solver for real time simulation of combustion and complex emission formation such as soot and NO_X
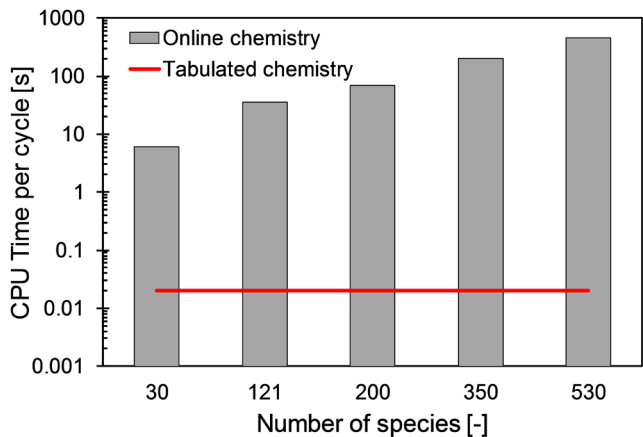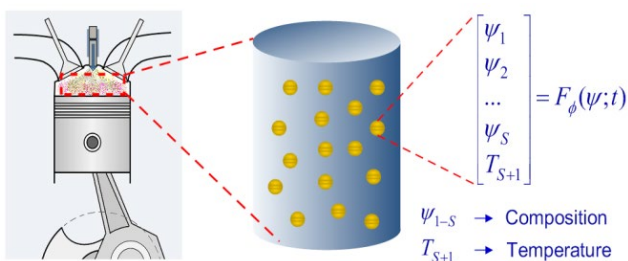

Summary of computational cost reduction thanks to LOGE's tabulated chemistry based solver.

Schematic representation of the SRM modelling concept.

$$\begin{bmatrix} \psi_1 \\ \psi_2 \\ ... \\ \psi_S \\ T_{S+1} \end{bmatrix} = F_\phi(\psi;t)$$

$\psi_{1-S} \rightarrow$ Composition
$T_{S+1} \rightarrow$ Temperature

Recent publications

Pasternak, M. et al., *Diesel engine performance mapping based on the parametrized mixing time model*, International J of Engine Research, Vol. 19(2) 202–213, 2018.

Netzer, C., et al., *Engine Knock Prediction and Evaluation Based on Detonation Theory Using a Quasi-Dimensional Stochastic Reactor Model*, SAE Technical Paper 2017-01-0538, 2017.