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Automated Calibration of an Analytical Wall-Wetting Model

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ABSTRACT

This paper describes the development and automated calibration of a compact analytically based model of the wall-wetting phenomenon of modern port fuel-injected (PFI) spark-ignition (SI) gasoline engines. The wall-wetting model, based on the physics of forced convection with phase change, is to be used in an automated model-based calibration program.

The first stage of work was to develop a model of the wall-wetting phenomenon in Matlab. The model was then calibrated using experimental data collected from a 1.8-litre turbocharged I4 engine coupled to a dynamic 200kW AC dynamometer.

The calibration was accomplished by adopting a two stage optimization approach. Firstly, a design of experiments (DoE) approach was used to establish the effect of the principal model parameters on a set of metrics that characterized the magnitude and duration of the measured lambda deviation during a transient. This DoE was used to identify the region in which the best calibration for the model was located.

Secondly, the calibration was refined using an automated iterative script which estimated new settings for the model parameters with the target of minimizing the error between measured and simulated lambda traces.

The model developed is able to accurately predict the magnitude and duration of lambda excursions during transient events. Furthermore the model is capable of representing the change in lambda excursions arising from variations in ambient conditions.