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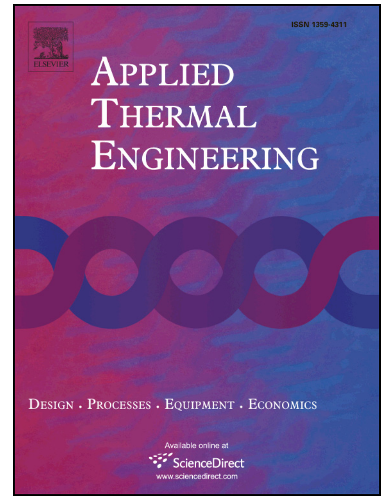

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In-cylinder pressure based model for exhaust temperature estimation in internal combustion engines

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Abstract

Exhaust temperature is a valuable parameter for engine control. However, measurement conditions at the engine exhaust and the slow dynamic response of temperature sensors difficult the determination of the instantaneous exhaust temperature. The present paper proposes a methodology for estimating the exhaust temperature exclusively relying in-cylinder pressure signal, engine speed and exhaust lambda.The presented methodology can replace or actualize widespread look-up table models for correcting calibration offsets, due to ageing, sensor bias or disturbances associated with the engine operation. The method uses the existence of resonant modes in the in-cylinder pressure for inferring the trapped mass and the in-cylinder temperature. An isentropic expansion of the gasses through the valves is assumed for estimating the cylinder outlet temperature of the gases, and the gas temperature drop along the exhaust runner and manifold is modelled through a nodal thermal model. The method was compared with current models under steady and transient conditions in a four stroke CI engine. Variations of injection, EGR, intake pressure and rail pressure were performed under steady operation and the transient response of the method was validated under specific transient test and at the WLTP cycle. A time invariant first order model was used for comparing the estimated temperature with that provided by the experimental sensors.

Keywords: Internal combustion engines, temperature, measurement, estimation, in-cylinder pressure, models, virtual sensors, exhaust