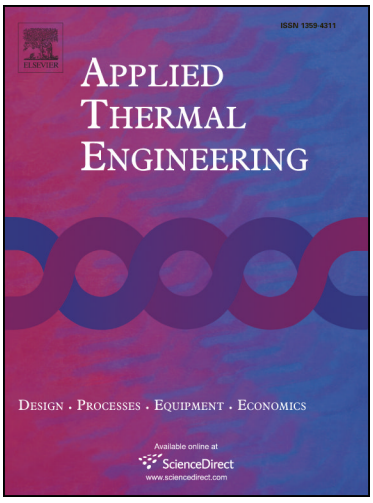

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PII: S1359-4311(17)31085-2
DOI: http://dx.doi.org/10.1016/j.applthermaleng.2017.08.102
Reference: ATE 10985

To appear in: *Applied Thermal Engineering*

Received Date: 18 March 2017
Revised Date: 5 August 2017
Accepted Date: 20 August 2017

Please cite this article as: A.K. Haghighat, S. Roumi, N. Madani, D. Bahmanpour, M.G. Olsen, An intelligent cooling system and control model for improved engine thermal management, *Applied Thermal Engineering* (2017), doi: http://dx.doi.org/10.1016/j.applthermaleng.2017.08.102

An intelligent cooling system and control model for improved engine thermal management

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HIGHLIGHTS

- An intelligent cooling system and engine cooling system model for an internal combustion engine were investigated
- The intelligent system consisted of an electrical water pump, and electrical fan, and a heated thermostat
- The model was based on engine characteristics derived from experiments on a 1.4 L engine
- The intelligent cooling system decreased fuel consumption by 1.1% and decreased hydrocarbon and CO emissions by 5.3% and 6.1% compared to a conventional cooling system under the NEDC cycle
- Engine performance was improved over all parts of the NEDC cycle, including warm up and both high and low load operating conditions

Abstract

A controlling model for the cooling system of an engine was developed in order to reduce fuel consumption and engine emissions through the use of controllable engine cooling components including an electrical water pump, an electrical fan, and a heated thermostat. The model was based on engine characteristics that were derived from experiments on a 1.4L engine. The results of simulations using the derived engine model showed that fuel consumption is decreased 1.1% and hydrocarbon and carbon monoxide emissions are reduced 5.3% and 6.1%, respectively, for the intelligent cooling system under NEDC cycle operation compared to a conventional cooling system. Engine performance was improved over all parts of the NEDC cycle, including engine warm up and both high and low engine load conditions. In non-cold start situations, the integration of an electrical water pump proved especially beneficial. For instance, if the initial coolant temperature is equal to 80°C, the energy consumption for an electrical water pump is less than half of that of a mechanical water pump. Considering both the potential fuel savings and emission reductions, it is beneficial to substitute the active controllable components described in this work for conventional mechanical components that provide insufficient cooling during various engine operation conditions while requiring greater energy to both increase fuel efficiency and reduce pollutant emissions.

Keywords

Intelligent cooling system, Thermal management, Engine efficiency, Heated thermostat, Electrical water pump, Variable speed fan

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