Design and Development of a Model-Based Feedback Controlled Cooling System for Heavy Duty Diesel Truck Applications Using a Vehicle Engine Cooling System Simulation

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Abstract

A thermal management system for heavy duty diesel engines is presented for maintaining acceptable and constant engine temperatures over a wide range of operational conditions. It consists of a computer controlled variable speed coolant pump, a position controlled thermostat, and a model-based control strategy. An experimentally validated, diesel engine cooling system simulation was used to demonstrate the thermal management system's capability to reduce power consumption. The controller was evaluated using a variety of operating scenarios across a wide range of loads, vehicle speeds, and ambient temperatures. Three metrics were used to assess the effects of the computer controlled system: engine temperature, energy savings, and cab temperature. The proposed control system provided very good control over the engine coolant temperatures while maintaining engine metal temperatures within a desired range. Less power is needed for the coolant pump which now provides lower and variable coolant flow rates based on engine operating conditions, and the fan power was also reduced in most cases.