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An Approach to Control Electric Automotive Water Pumps Deploying Artificial Neural Networks

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Abstract : With the global shift towards sustainability and technological advancements, electric Hybrid vehicles (EHVs) are increasingly considered viable alternatives to traditional internal combustion (IC) engine vehicles, which also require efficient cooling systems. The electric Automotive Water Pump (AWP) has been introduced as an alternative to IC engine belt-driven pump systems. However, current control methods for AWPs typically employ fixed gain settings, which are not ideal for the varying conditions of dynamic vehicle environments, potentially leading to overheating issues. To overcome the limitations of fixed gain control, this paper proposes the implementation of an artificial neural network (ANN) for managing the AWP in EHVs. The proposed ANN provides an intelligent, adaptive control strategy that enhances the performance of the AWP, supported through simulation work in MATLAB illustrated in this paper. The comparative analysis demonstrates that while the PID controller provides a fast response of 0.1sec, it has an overshoot of 51.4%. The FLC offers stability and zero overshoot but at the expense of a slower response of 6.7secs. The ANN controller outperforms both, delivering a rapid response of 0.1secs, zero overshoot, 0.0696 IAE, and high precision, making it the most effective control method for AWPs. The ANN's adaptive learning capabilities allow it to manage the complexities and non-linearity of automotive systems more effectively than traditional control methods.

Keywords : automotive water pump, cooling system, electric hybrid vehicles, artificial neural networks, PID control, fuzzy logic control, IAE, MATLAB
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