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Data Driven Temperature Estimation of PMSM with Regression Models

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Abstract:

Monitoring temperature parameters in Permanent Magnet Surface Machine (PMSM) is crucial since the machine possesses applications in several diverse areas, for instance, traction drives, electric vehicles, besides applications that require control of rotor temperature in order to ensure safety and cost-effectiveness. The thermal losses produced in the permanent magnet synchronous machine such as copper, iron, and mechan-ical loss and the cooling modes are responsible for temperature rise in the PMSM. The basic method to evaluate the temper-ature of internal components like Lumped Parameter Thermal Networks (LPTN) does not provide the degree of freedom in terms of choosing model parameters, physical comprehensibility, and real-time requirements. Hence, in this work a real-time data collected from the Germany laboratory is considered to perform the various machine learning techniques in which the effect of stator temperature, coolant temperature, and ambient temperature are contemplated to estimate the permanent magnet surface temperature. This paper has accomplished a data-driven temperature estimation of four regression models that are Linear Regression, Stochastic Gradient Regression, Random Sample Consensus (RANSAC) Regression, and Random Forest Regression training models by considering Mean Absolute Error (MAE), Mean Square Error (MSE), and R2-Score as measuring parameters and for unambiguous understanding, the predicted and the actual results are elaborated. This study is evident that Random Forest Regression model is proved to have the best outcomes out of all four regressoion models exercised in this research.

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