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Empirical Parameter Identification for a Hybrid Thermal Model of a High-Speed Permanent Magnet Synchronous Machine

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Abstract:
An accurate thermal model will commonly require empirical parameter identification, specifically for the convection coefficients and interface resistances. A high-speed permanent magnet synchronous machine test platform, equipped with various temperature and power measuring equipment, is used to determine these parameters. Specifically, two tests, a dc injection test and rotational test with no load connected, were performed. The results were compared with a lumped thermal model and the parameters updated until an acceptable match was achieved. There were significant differences in the temperature rise when activating forced air cooling, thus significantly influencing the convection coefficients. Also, a significant difference in the interface resistances showed that in these high-speed machines, doing only the dc injection test will not give accurate interface resistance values. The work is novel through combining systematic empirical parameter identification to determine the convection coefficients and interface resistances for a machine where the end windings are cooled by forced tangential air flow.