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# Processing and inferential methods to improve shaft-voltage-based condition monitoring of synchronous generators

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# Abstract

This thesis focuses on improving shaft-voltage-based condition monitoring of synchronous generators. The work presents theory for describing and modelling shaft voltages using fundamental electromagnetic principles. A modern framework is adopted in developing an online, automated and intelligent fault-diagnosis system. Novel processing and inferential methods are used by the system to provide accurate and reliable incipient-fault detection and diagnosis. The literature shows that shaft-voltage analysis is recognised as a technique with potential for use in condition monitoring. However, deficiencies in the fundamental theory and the inadequacy of methods for extracting useful information has limited its widespread application. This work extends the knowledge of shaft voltages, validates the merits of its use for fault diagnosis, and provides methods for practical application. Validation of the model is completed using an experimental synchronous generator, and results indicate that simulated shaft voltages compare well with the measurements - i.e. total average error of the model combined with experimental uncertainty is below 16%. The fault detection and diagnosis components are tested separately and together as a complete shaft-voltage-based condition-monitoring system in an experimental setting. Results indicate that the system can accurately diagnose faults and it represents a unique and valuable contribution to shaft-voltage-based condition monitoring. Additionally, techniques such as optimal measurement selection, multivariate model monitoring, and fault inference developed for the investigations and system presented in this thesis, will assist engineers and researchers working in the field of condition monitoring of electrical rotating machines.