Plan Overview

A Data Management Plan created using DMPTool-Stage

Title: Quiet Switched Reluctance Motor Drives: A Holistic Approach

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Project abstract:

Switched Reluctance Motor (SRM) drives present a great potential for utilization in adjustable speed applications such as electric traction, pumps, fans, and industrial drives. This potential, for the most part, has not been explored by the industry due to the presence of substantial acoustic noise and vibration in this family of electric machines. The proposed three-fold design and control strategy will guarantee a quiet operation of the SRM drive without penalizing efficiency or torque density of the motor drive system. The abrupt rise in tangential forces at the point of overlap and the sudden decline of the radial forces at or about aligned position where the stator phases are turned-off are the attributes of a discontinuous rotating magnetic field in SRM drives. Our preliminary studies show that tangential forces acting on the corner tips of the stator poles at the verge of overlap with rotor poles initiate a tangential motion in the stator frame. This tangential motion is then combined with a centripetal motion during turn-off process where radial forces exhibit very large magnitudes. Transmission of the stator and rotor vibrations to the outer and inner races of the bearing will further ignite a third vibration in the bearing. This proposal aims to eliminate vibration and acoustic noise in SRM drives by (a) introducing a novel rotor configuration that mitigates the sudden change in tangential forces at the point of overlap between the rotor and stator, (b) a new switching strategy that eliminates the sudden change in radial vibration of the stator frame during turn-off process, and (c) a novel design for the endcaps to mitigate the vibration caused by the bearings. The proposed solution will not only mitigate the source of tangential vibration in the stator but will result in a symmetric distribution of the torque-angle profile. This symmetry will further reduce the torque pulsation that is the main cause of speed pulsation at low speeds in low inertia applications and can cause secondary problems in certain loads such as electric-assisted steering system. Optimal design of the active (rotor geometry) and passive (endcap geometry) will be done using evolutionary genetic algorithms while the selection and tuning of the switching method will be based on the mechanical impulse response of the motor. The proposed project if executed successfully can bring about a fundamental change in application of SRM drives over a wide range of

applications. Given the cost of manufacturing, ruggedness, fault tolerance, and wide range of speed in constant power region quiet SRM drives have the potential to change many industries, reduce the dependency to rare-earth metals, and create many jobs in the United States and around the globe.

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It is expected to record experimental data including current, voltage, acceleration, efficiency, torque pulsation, and acoustic noise from our experimental setup. It is also planned to develop comprehensive numerical models of the electromagnetic and structural system using finite element analysis. The numerical models and experimentally gathered measurements form the bulk of recorded data in this project.

The collected data from experiments output are usually in ASCII or excel data sheet format. The data will be retrieved using USB and will be stored on Lab main computer and external hard-drive. A copy of the data will be stored on BOX as a backup.

Publication of the results in prominent IEEE conferences and other peer reviewed venues such as IEEE transactions and journals is the most frequently used method of dissemination. In addition, some of the data maybe presented to public in the form of invited keynote speeches. Release of the data to public will follow a determination on having disclosed all novel technologies or discoveries to the office of sponsored research.

The data collected in the course of this project will be retained at UT-Dallas and will not be re-used without prior permission from the University of Texas at Dallas office of sponsored research.

All dissertation and theses emerging from this project will reside in the library of the University of Texas at Dallas. A copy of all measurments, writings and published work, and disclosures will be archived at the Renewable Energy and Vehicular Technology Laboratory at UT-Dallas.
