
Plan Overview

A Data Management Plan created using DMPTool

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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Quiet Switched Reluctance Motor Drives: A Holistic Approach

Products of Research

What types of data (experimental, computational, or text-based), metadata, samples, physical collections, models, software, curriculum materials, and other materials will be collected and/or generated in the course of the project? The DMP should describe the expected types of data to be retained, managed, and shared, and the plans for doing so. What descriptions of the metadata are needed to make the actual data products useful and reproducible for the general researcher? For collaborative proposals, the DMP should describe the roles and responsibilities of all parties with respect to the management of data (including contingency plans for the departure of key personnel from the project) both during and after the grant cycle.

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.

Data Formats and Standards

In what format and/or media will the data or products be stored (e.g., hardcopy notebook and/or instrument outputs, ASCII, html, jpeg or other formats)? Where data are stored in unusual or not generally accessible formats, how may the data be converted to more accessible formats or otherwise made available to interested parties? When existing standards are absent or deemed inadequate, this should be documented along with any proposed solutions or remedies. In general, solutions and remedies to providing data in an accessible format should be offered with minimal added cost.

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.

Dissemination, Access and Sharing of Data

What specific dissemination approaches will be used to make data available and accessible to others, including any pertinent metadata needed to interpret the data? In this case, "available and accessible" refers to data that can be found and obtained without a personal request to the PI, for example by download from a public repository. What plans, if any, are in place for providing access to data, including websites maintained by the research group and contributions to public databases/repositories? For software or code developed as part of the project, include a description of how users can access the code (e.g., licensing, open source) and specific details of the hosting, distribution and dissemination plans. If maintenance of a website or database is the direct responsibility of the research group, what is the period of time the website or database is expected to be maintained? What are the practices or policies regarding the release of POST-AWARD MANAGEMENT data – for example, are they available before or after formal publication? What is the approximate duration of time that the data will be kept private? "Data sharing" refers to the release of data in response to a specific request from an interested party. What are the policies for data sharing, including, where applicable, provisions for protection of privacy, confidentiality, intellectual property, national security, or other rights or requirements? Research centers and major partnerships with industry or other user communities should also address how data are to be shared and managed with partners, center members, and other major stakeholders; publication delay policies (if applicable) should be clearly stated.

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.

Re-Use, Re-Distribution and Production of Derivatives

What are your policies regarding the use of data provided via general access or sharing? For data to be deemed "re-usable," it must be accompanied by any metadata needed to reproduce the data, e.g., the means by which it was generated, detailed analytical and procedural information required to reproduce experimental results, and other pertinent metadata. Practices for appropriate protection of privacy, confidentiality, security, intellectual property, and other rights should be communicated. The rights and obligations of those who access, use, and share your data with others should also be clearly articulated. For example, if you plan to provide data and images on your website, will the website contain disclaimers or condition regarding the use of the data in other publications or products?

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.

Archiving of Data

When and how will data be archived and how will access be preserved over time? For example, will hardcopy logs, instrument outputs, and physical samples be stored in a location where there are safeguards against fire or water damage? Is there a plan to transfer digitized information to new storage media or devices as technological standards or practices change? Will there be an easily accessible index that documents where all archived data are stored and how they can be accessed? If the data will be archived by a third party, please refer to their preservation plans (if available). Where no data or sample repository exists for collected data or samples, metadata should be prepared and made publicly available over the Internet and the PI should employ alternative strategies for complying with the general philosophy of sharing research products and data as described above

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