I. Introduction
1. Inductance based model of switched reluctance motor, with damper windings added to represent losses
2. Different model structures for SRM at standstill and during operation (with saturation)
3. A two-layer recurrent neural network is setup and trained to help estimate SRM parameters

II. Inductance Model Structures of SRM

The phase inductance can be expressed as a Fourier series with respect to rotor position angle \( \theta \).

\[
L(\theta, i) = \sum_{n=1}^{Nr} L_n(i) \cos n\theta
\]

where \( Nr \) is the number of rotor poles.

(a) Model structure at Standstill
(b) Model structure of SRM under saturation
(c) Alternative model structure of SRM under saturation

III. Neural Network based Modeling of SRM

A two-layer recurrent neural network. The first layer is the input layer. The inputs to the network are \( V, i, \theta, \omega \) (with possible delays). One of the outputs, the current \( i \), is also fed back to the input layer to form a recurrent neural network.

IV. Experimental Testbed

The switched reluctance motor used in this test is an 8/6 SRM. An induction motor is coupled with the SRM as the load. Tests are performed at different load conditions for current between 0~50 amperes.

V. Estimation Results

A 3-D plot of inductance that depicts the profile of inductance versus rotor position and phase current.

The flux linkage versus rotor position and phase current based on the estimated inductance model.

VI. Model Validation – Comparing estimated currents with measured current

Results shown that the model with one damper winding models the dynamics of SRM better than standstill model. However, the model with two damper windings doesn't give better results.

(a) Validation of standstill model
(b) Validation of model with one damper winding
(c) Validation of model with two damper windings

VII. Conclusions

This paper presents the idea to model the phase winding of switched reluctance motor by a magnetizing inductance and one or two damper windings. A 2-layer recurrent neural network is setup and trained with simulation data. By applying this neural network to online operating data, the damper currents can be estimated and the damper parameters can be identified.