Design and Experimental Validation of Skewed Pole Linear Switched Reluctance Motor

M Sridhar[1] and K Ashoka[2]
Department of Electronics and Communication Engineering, MVGR College, Vizianagaram
[1]Corresponding Author: sridharece@gmail.com

To Cite this Article
Sridhar, "Design and Experimental Validation of Skewed Pole Linear Switched Reluctance Motor", Journal of Innovative Research in Engineering Technology and Management Science, Vol. 01, Issue 02, June 2025, pp:08-10,

Abstract*: Based on this analysis, the linear switched reluctance motor (LSRM) with skewed poles was studied to lower thrust ripple and decrease the total noise. Altering the flux path in a skewed pole fashion results in smoother operation and increased efficiency. Conventional and skewed LSRMs are modelled and analyzed with FEA under electromagnetic conditions. The results of simulations show that skewing allows for reduced torque ripple and detent force, without decreasing thrust force. This investigation has demonstrated that skewed poles help improve the motion capability of LSRMs.*

Keywords*: Finite element analysis, FFT, Force ripple, Reluctance motor switch, Pole skewed*

I. Introduction

The growing popularity of linear switched reluctance motors or LSRMs, is due to their easy design, durability and usefulness for direct linear motion. Because traditional LSRMs have an inherently salient design, they suffer great pressure fluctuations, loud noises and vibrations. Specific arrangements of magnetic poles in windings have been added to take care of these issues. To make thrust ripple smaller and force smoother, the research explores how to design and analyze an LSRM with skewed poles. The study makes use of simulation to show how skewing improves motor behavior.

II. LSRM Topology

A linear switched reluctance motor (LSRM) consists mainly of a stator and a translator (mover) for its direct and resilient form. The translator is laminated soft magnet material with salient poles on both parts, without windings and using no magnets, so it remains low-cost and easy to use. LINEAR MOTION The stator's concentrated windings are energized in a sequence, creating a different reluctance path for the magnet. Even though it induces thrust ripple, the twin member structure makes the force even greater. Introducing pole skewing is a major strategy being considered to solve such performance issues.

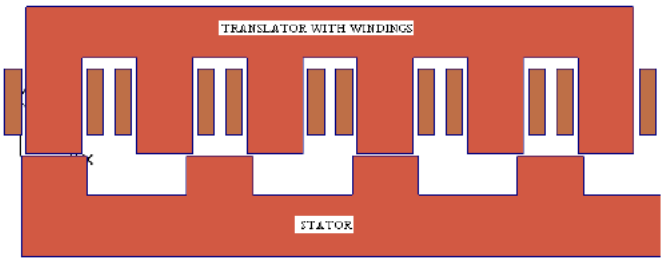

Fig 1: LSRM 2D cross sectional model of conventional

III. Two-Dimensional Finite Element

Because it is accurate and uses less computation, two-dimensional finite element analysis (2D FEA) is commonly used to analyze linear switched reluctance motors (LSRMs). In 2D FEA, the motor's cross-section is cut

into a series of simple elements before inspecting electromagnetic field equations. The approach is able to measure properties such as flux distribution, inductance fluctuations and force generation. Having the ability to picture magnetic behavior and forecast thrust and detent forces enables LSRM designers to properly analyse pole skewing without significantly raising development costs.

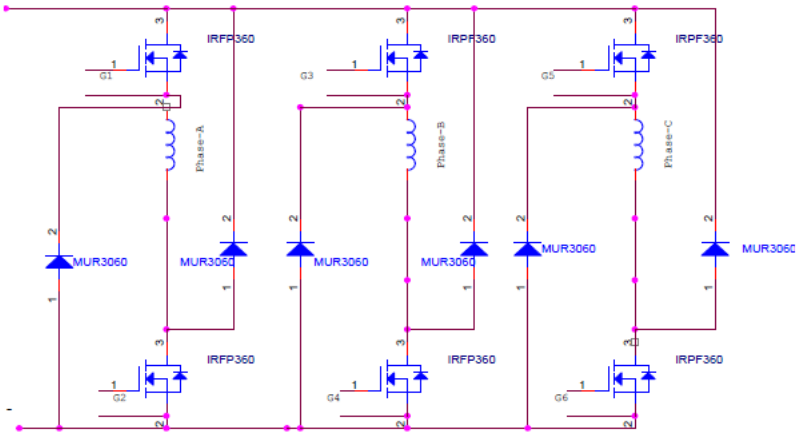

Fig 2: LSRM Three phase power converter

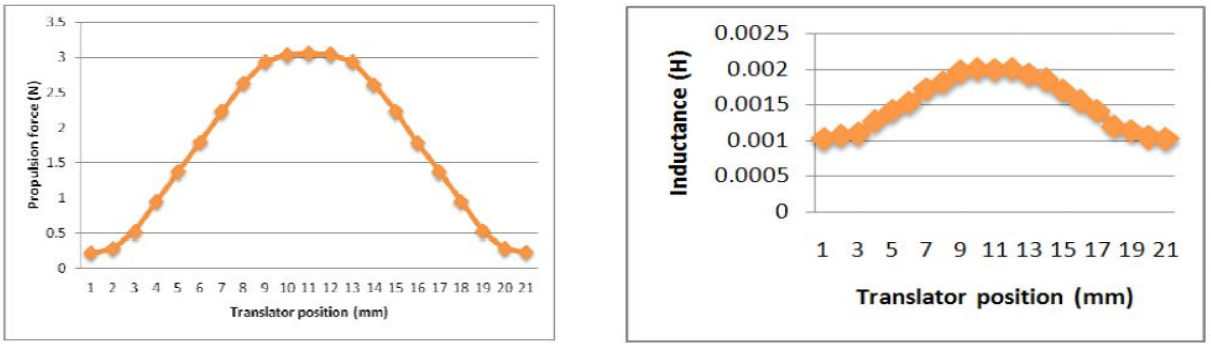

Fig 3: Propulsion force for base motor

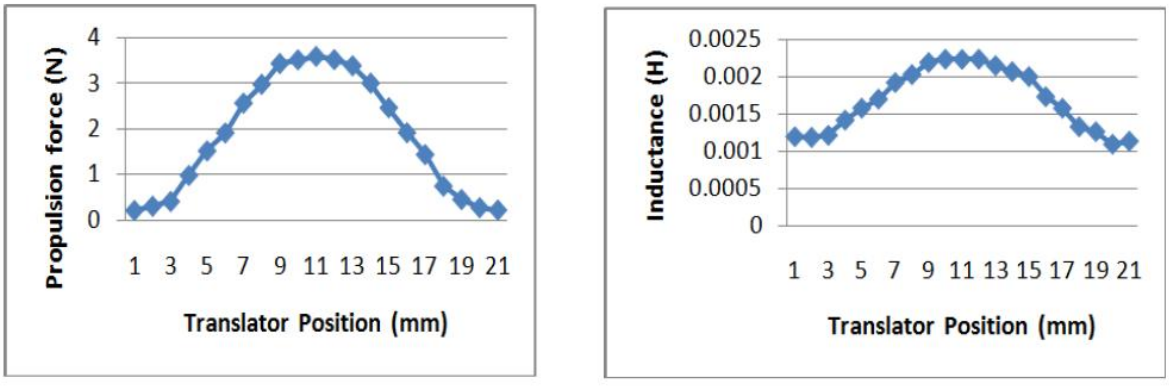

Fig 4: Inductance Profile for proposed motor

IV. Conclusion

Because of its simplicity, low price and dependability, the Linear Switched Reluctance Motor (LSRM) can be used successfully in direct-drive linear motion applications. With skewed poles and fewer force changes, stamen designs can achieve much better results even when they deal with issues such as thrust ripple and acoustic noise. It is possible to predict the results of such changes with accuracy using simulation and analysis in 2D Finite Element Analysis. Overall, LSRMs are proven to be efficient, low-requiring actuators, making them suitable in places where high accuracy and toughness are required.

References

[1] D Matt, R Goyet, J Lucidarme, C Rioux, Longitudinal-field multi-air gap linear reluctance actuator, *Elect. Mach. Power Syst.*, 1987; 13(5): 299–313.

[2] K Takayama, Y Takasaki, A new type switched reluctance motor, *IEEE Transactions on Industry Applications*, 1988; 23(5): 71-78.

[3] Mimpei Morishita, A new maglev system for magnetically levitated carrier system, *IEEE Transactions on Vehicular Technology*, 1989; 38(4): 230-236.

[4] PM Cusack, GE Dawson, TR Eastham, *Design, control and operation of a linear switched reluctance motor*, Proc.Canadian Conf. Electrical and Computer Engineering, Quebec, PQ, Canada, 1991; 19.

[5] J Corda, E Skopljak, *Linear switched reluctance actuator*, Proc. Sixth Int. Conf. Electrical Machines and Drives,Oxford, U.K, 1993; 535–539.