

Master project, 2016-17

3D calculation on induction motor: analysis of axial forces.

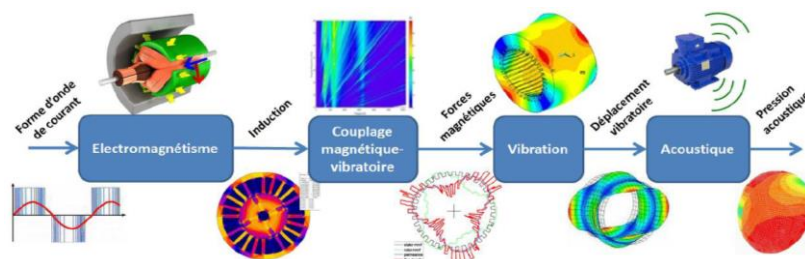
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Context

The design of a new generation of motors must incorporate new constraints as the noise of electromagnetic origin. In order to reduce electromagnetic noise, the knowledge of electromagnetic forces is essential versus frequency and spatial order. These forces are estimated by finite element approach or analytical model with approximation.

Multi-physics models are developed: magnetic, mechanical and acoustic models [1]. These models identify the electromagnetic forces and harmonics but the difficulties are to deduce the 'source' effects of these forces.



Objectives

The study will focus on squirrel cage induction motor [2]. The objective is to predict the impact of rotor skewing on noise. Until now to estimate the electromagnetic noise we only based on the electromagnetic radial forces in the air gap. When the rotor is skewed, this model does not explain certain phenomenon as the vibration in axial direction which can be source of additional noise.

Here, we extend our study taking into account the tangential and axial forces to better understanding phenomenon.

Different stages of work

- 1) Bibliographical synthesis on the magnetic noise in induction machines and the effect of the skewing. Magnetic noise on induction motor and effect of skew. Which model in order to integrate the rotor skew: 2D-multi-slice or 3D? Which model to calculate the axial force?
- 2) 2D (multi-slice technique) and 3D simulations with finite element method in order to estimate the impact of rotor skewing [3][4].
- 3) Determination of harmonics of the forces. Analysis and comparison with analytical expression.
- 4) Report writing.

References

- [1] G. Jacek F., W. Chong, and C. L. Joseph, *Noise of polyphase Electric motors*, Taylor & F. 2006.
- [2] J. Le Besnerais, "Reduction of magnetic noise in PWM-supplied induction machines - low-noise design rules and multi-objective optimisation," 2008.
- [3] J. J. C. Gyselinck, L. Vandeveld, and J. a Melkebeek, "Multi-slice FE modeling of electrical machines with skewed slots - The skew discretization error," *IEEE Trans. Magn.*, vol. 37, no. 5 I, pp. 3233–3237, 2001.
- [4] R. Carlson, S. Member, C. Andréa, N. Sadowski, Y. Lefevre, and M. Lajoie-mazenc, "Analysis of the Effect of Inter-Bar Currents on the Performance of Polyphase Cage-Induction Motors," *IEEE*, vol. 39, no. 6, pp. 1674–1680, 2003.