

Master project, 2024-2025

TOPOLOGICAL OPTIMIZATION AND ADDITIVE MANUFACTURING FOR LOW-NOISE ELECTRICAL MACHINES

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Context

Electrical machine design is a complex subject. Having tools to help design is a necessity. Choosing a shape or structure is not an easy task, especially when the notion of vibration and noise is taken into account. Numerous phenomena and constraints are present, and designers need tools to support their choices. Additive manufacturing is opening up new possibilities in terms of shape. A thesis with Jeumont Electric will be submitted on this topic. The Master's subject will enable the work to begin. The modeling part will be mainly developed in this master's subject, moving towards optimization.

Objective

The aim of this Master's project is to adapt a magnetic equivalent model (MEC) to electrical machines [1]. It should take into account saturation and machine rotation. This model will be coupled to an existing vibro-acoustic model [2]. The model will then be used for parametric and topological optimization [3].

Expected results

- Development of a MEC model dedicated to electrical machines
- Test on a simple Jeumont Electric structure
- Identify and solve a simplified topological optimization problem based on the developed model
- print some shapes obtained by the optimization process

Keywords

magnetic equivalent circuit (MEC); electric machine, design by optimization, topology optimization,

References

[1] D. FU, J. GONG, Y. XU, F. GILLON and N. BRACIKOWSKI, "Coupled Circuit and Magnetic Model for a Transverse Flux Permanent Magnet Linear Motor," in *IEEE Access*, vol. 8, pp. 159274-159283, 2020, doi: 10.1109/ACCESS.2020.3020258.

[2] Emré UYGUN, "Étude acoustique d'entraînements électriques de faible puissance produits en grande série", Thèse de doctorat, L2EP.

[3] MOHAMODHOSEN Bilquis, GILLON Frédéric, TOUNZI Abdelmounaïm, CHEVALLIER Loïc "Topology Optimisation using Nonlinear Behaviour of Ferromagnetic Materials" in *The International Journal for Computation and Mathematics in Electrical and Electronic Engineering (COMPEL)*, 09/2018

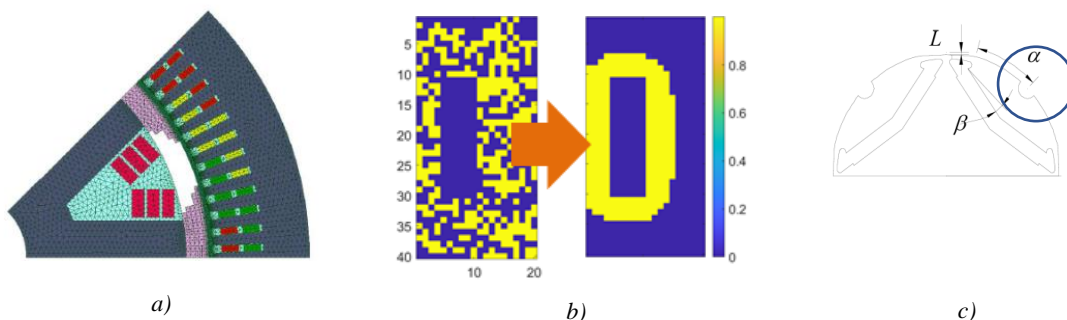


Figure 1. a/optimization of the pole shape, b) Optimization process of a E core, c) Noise reduction by adding a notch