

Master project, 2018-2019

— Simulation of transient phenomena in the electrical machine by finite element method —

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Context

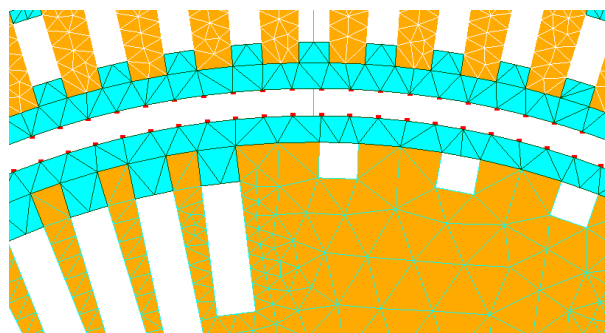
Since more than 15 years, the team numerical Tools and Methods of the L2EP and EDF R&D develop together a 3D software to compute the Maxwell equations in low frequency; Code_Carmel (<http://code-carmel.univ-lille1.fr/>). From this collaboration, a common laboratory (LAMEL, <http://lamel.univ-lille.fr/>) has been created in 2006.

Code_carmel can simulate, with a very good accuracy, the behavior of electrical converters such as transformers, synchronous or induction machines. As such, it needs to be upgraded constantly in order to improve its quality; accessibility and usability. In this context, a new method to take into the movement, the overlapping method, has recently been introduced in order to simulate variable speed drives.

Objective

The objective of the project is double.

1. First, the overlapping method has to be validated through the modelling of a simple machine such as a synchronous permanent magnet machine in 2D. Moreover, as the mechanical equation was also added, it should be validated as well.
2. Secondly, the run up of an induction machine should be simulated and the results compared to the measurements. This induction machine is used as a pump in electrical nuclear power plant and needs to be modelled in 3D to take into account the leakage flux.



Mesh of the machine air gap for the overlapping method

Work steps

- Bibliographic study:
 - Regarding the transient model of the machine.
 - Regarding the numerical approach to model transient phenomena in the electrical machine
- Model a synchronous machine with dampers
- Determine by finite element the equivalent electrical scheme of the machine (determination of transient and subtransient inductance)
- Compare both approaches
- Carry out the same study with an induction machine

Key word

- Modelling
- Induction machine
- Overlapping method

References

- [1] I. A. Tsukerman, « Overlapping finite elements for problems with movement », *IEEE Transactions on Magnetics*, 28(5) :2247–2249, 1992.
- [2] X. SHI, « Contribution à la simulation du mouvement en 3D avec la méthode des éléments finis appliquée à la machine », Décembre 2005.
- [3] O. Kokoko, A. Tounzi, A. Merkhouf, E. Guillot, K. Al Haddad, « Characterization and validation of a large hydrogenerator under dynamic conditions », *ICEM 2016*.