# *Computation of matrix impedance of electrical machines*

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## Context

To study the behavior and/or the performance of an electrical machine, different models exist, from the simplest one based on a linear equivalent diagram with few components (monophase equivalent model) to very complex numerical models that can implement till millions of unknowns. The latter are very accurate but very time consuming as well which does not allow using them as a part of much more simulation system, for example in a software that studies the behavior of the electrical grid taking into account as accurately as possible the state of the alternators. On the other hand the simplest model are not suitable in such software as the results are not enough accurate. One solution would be the development of an analytical model that is more complete than the widely used ones by introducing in a deeper way the magnetic interaction between the different windings. This can be achieved through the identification of the inductances between all the windings of the machine versus the rotor position while taking into account the nonlinear behavior of the magnetic material. These inductances can also, in a certain level, take into account some slight faulty conditions of the machine due to its construction such as rotor eccentricities.

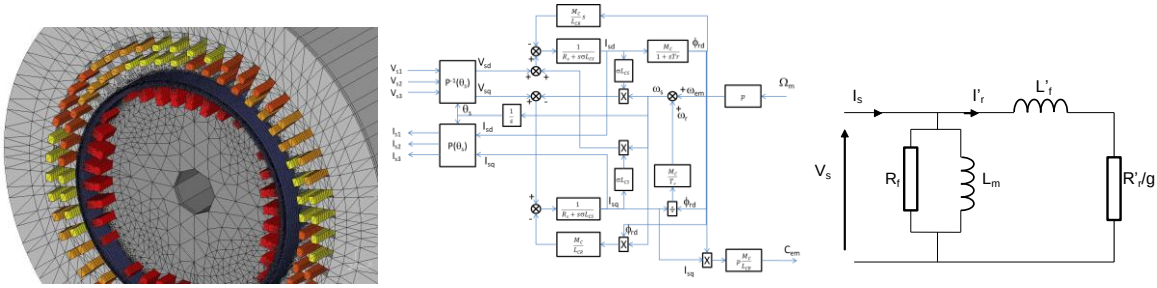


Fig. Different models of electrical machines

## Objectives

The proposed work fits within the frame of the Lamel which is a common Lab between the L2EP and EDF R&D. The goal consists in establishing the meta-model of a given electrical machine that contains, in addition to the armature windings, bars relative to dampers or a squirrel cage. From simulations conducted using numerical model based on finite element, the self and mutual inductances between all windings will be calculated in order to obtain a matrix model that links the different currents in the machine. In addition, the model should take into account the position of the rotor along with the non-linear behavior of the magnetic materials. Once the meta-model determined, it will be implemented in matlab powersystem environment to evaluate it by comparing its results to the ones obtained by other models at different operating points that can include faulty conditions.

## Progress

The work would proceed as follows:

1- State of the art of the different matrix models of electrical machines
2- Built up of the numerical model of a test machine
3- Identification of the inductances between the different windings in healthy and some faulty conditions
4- Use of the developed model to simulate some operating points of the machine and comparison of the results with the ones obtained by numerical simulation.

## References