

## Master project, 2017-2018

### — TOPOLOGY OPTIMIZATION APPLIED TO TRACTION ELECTRIC MACHINES —

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Proposal master subject to go towards thesis subject  
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#### CONTEXT

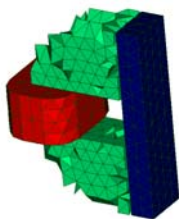
The topology optimization (TO) is a rising subject, allowing to see the emergence of new innovations electromagnetic devices. It's a new optimization technique allowing to obtain a new structure without any a priori [1],[4-5]. Emergence of these methods, ways of tackling the problem, becomes possible with the support of a computer but also with an acquired expertise by the designer. The topology optimization tool provides, a structure, a shape. This is obtained by a certain distribution of the material driven by an optimization process. Nevertheless, it is fundamental to define correctly the objectives and the constraints of the optimization problem in order to have a solution answering the needs.

**This kind of tool interests Valeo** to help its designers during the first steps of design for a good initial choice and drive it towards new innovations or reflections. The target applications are the electromagnetic devices for automotive applications.

#### IDEAS AND OBJECTIVES

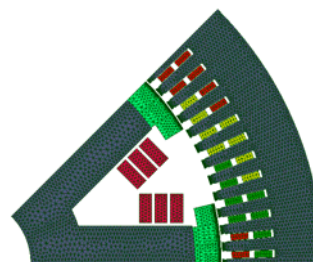
Then, the objective is to develop topology optimization methods applied to the electric machine design. **The key point is the integration of the automotive specificities** inside the optimization problem formulation. Methods will be used with finite element model or **with reluctance network**. **Different optimization strategies will be tested and compared**. Existing tool will be reused and applied on a benchmark [1-3].

#### SOME PICTURES



##### Electromagnet system :

The shape of the magnetic circuit is obtained with a topology optimization process. The elements of the mesh are activated as iron or air. The objective is to find the shape of the iron part (green part) in order to increase the attractive force for a fixed volume.



##### Electric machine :

The rotor shape of this synchronous machine is reached by optimization process. The objective is to have a sinusoidal waveform of the EMF with fixed amplitude.

#### BIBLIOGRAPHY

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- [4] T. Labbe and B. Dehez, "Convexity-Oriented Method for the Topology Optimization of Ferromagnetic Moving Parts in Electromagnetic Actuators Using Magnetic Energy," in *IEEE Transactions on Magnetics*, vol. 46, no. 12, pp. 4016-4022, Dec. 2010
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