

# MAXIMIZING INNOVATION IN E-MOTOR DESIGN USING MULTIPHYSICS DESIGN STRATEGIES

Future e-motors must be developed to fulfil more and higher requirements originating from internal, legal and customer sources. Failure to fulfil design targets will negatively affect the product competitiveness in the market.

In classical development strategies, different attributes of the motor are developed in silos, often leading to unfavorable compromises concerning attribute performance and added lead time to a feasible final design. It is often beyond comprehension to find the optimal trade-off of in Multiphysics development situations without an integrated, highly automatic, and holistic design strategy.

In the future, such holistic design strategy will be necessary, both considering the different physics requirements to be fulfilled, but also considering the e-motor to be an integrated component of the complete e-powertrain. Different physics and associated requirements must be considered simultaneously.

Altair is collaborating with leading OEMs and suppliers to develop a solution for Multiphysics e-motor design, the Altair eMotor Director. The eMotor Director facilitates a highly automated process to speed up e-motor design by facilitating Multiphysics simulation, Design-of-Experiments, rapid design exploration, and system-level optimization of Multiphysics electric powertrain design problems.

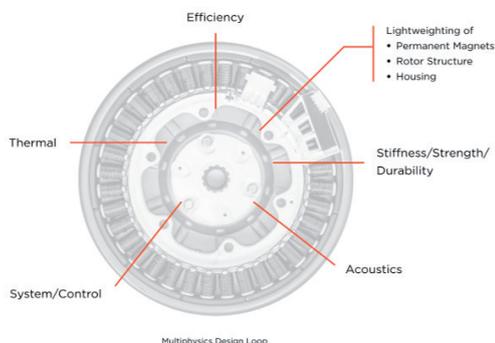


Fig. 1: e-Motor Multiphysics design loop

## Altair eMotor Director Overview

Altair's eMotor Director supports the implementation of a Multiphysics design process and steps to automate the process for efficiency and repeatability. The workflow allows to consider essential attributes, including electromagnetics, thermal, strength and NVH. It accommodates for design of experiments (DoE), optimization, machine learning and design exploration methods find feasible motor designs.

The process begins with domain experts from electromagnetics, durability, NVH, and cooling providing their best-practice simulation models. The Altair eMotor Director solution then joins all attribute models together and identifies the best design considering the various attribute targets. The tool supports target negotiation, trade-off studies and enables exploration of "what-if" scenarios based on DOEs executed using systematic design variations.

Altair focused its efforts on installing high levels of

automation and support to simplify the setup process and ensuring efficient handling of data to and from the various design process tasks. This simple process assures usage of consistent designable geometry throughout all simulations, a high degree of process automation, and a reliable data structure to handle the process.

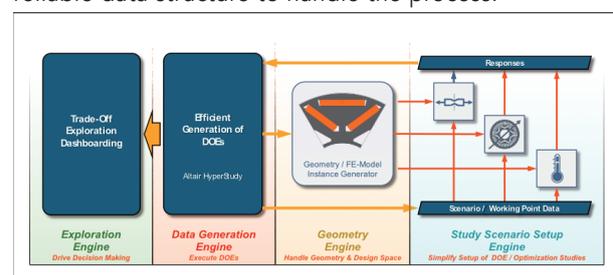


Fig. 2: Essential Modules of eMotor Director

An essential part of eMotor Director is concerned with optimization and design exploration. Based on created DOEs representing different concepts, optimization and design exploration will be possible to execute based on one single DOE or on multiple DOEs simultaneously, so-called multi-concept optimization. Upcoming versions of eMotor Director will additionally support the simultaneous optimization of a complete family of motors with different requirements on performance and carry-over content, see Figure 3.

The first official release of eMotor Director is planned for September 2021. However, already now Altair is working actively with OEMs to develop and deploy client specific functionalities in addition to the extensive standard functions of eMotor Director.

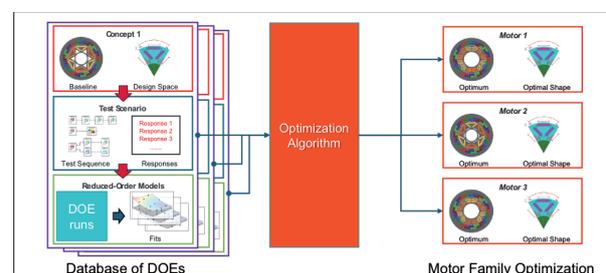


Fig. 3: Principles of Multi-Concept and Motor Family Optimization



**Lars Fredriksson,**  
Altair Vice President of global Automotive Business