

# FULLY AUTOMATED OPTIMIZATION ENGINE

## ZF EMPLOYS AN OPTIMIZATION ENGINE FOR THE DEVELOPMENT OF MODULAR MOTOR PLATFORMS

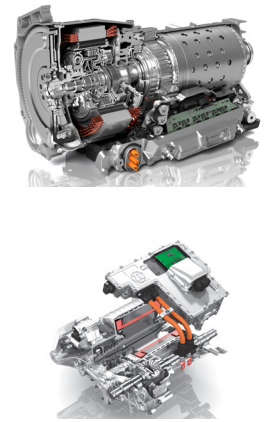
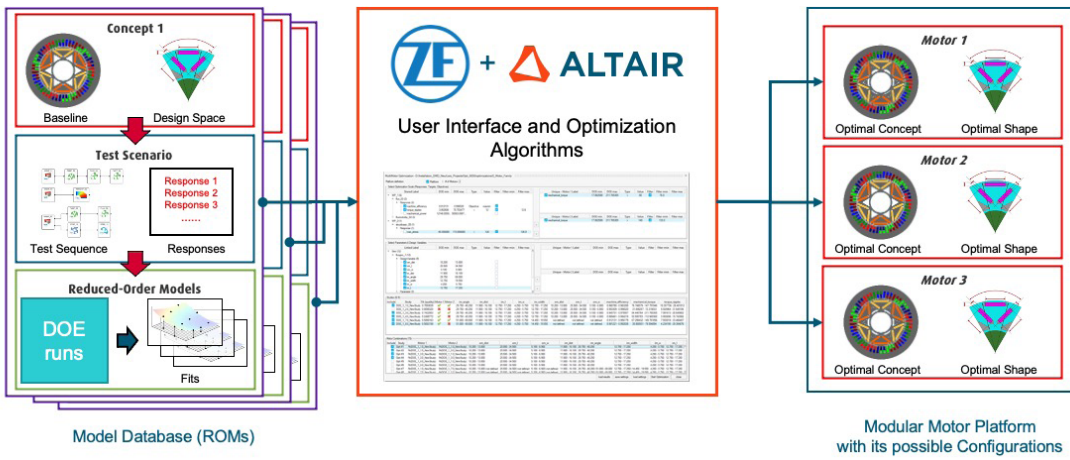
### About the Customer

ZF is a global technology company supplying systems for passenger cars, commercial vehicles, and industrial technology, enabling the next generation of mobility. ZF allows vehicles to see, think and act. In the four technology domains of Vehicle Motion Control, Integrated Safety, Automated Driving, and Electric Mobility, ZF offers comprehensive product and software solutions for established vehicle manufacturers and newly emerging transport and mobility service providers. ZF electrifies a wide range of vehicle types. With its products, the company contributes to reducing emissions, protecting the climate, and enhancing safe mobility.



The ability to systematically and optimally develop modular motor platforms from the ground up allows us to incorporate synergies and a common parts approach from the outset, resulting in flexible system solutions that are not simply technically advanced but also highly cost-effective.

Helmut Schmid, ZF



**LEFT:** Modular motor platform optimization. **TOP:** ZF 8-speed plug-in hybrid transmission. **BOTTOM:** Modular designed electric axle drive with integrated power electronics.

## Their Challenge

ZF develops a wide variety of e-motors and e-drives for a broad spectrum of automotive customers. To optimally incorporate development and production costs from the outset, their designers must find solutions to maximize shared parts within the given requirements for the motors. To achieve this, ZF groups products into motor programs that have similar design and production objectives and identifies common design features that can be used across a modular motor platform. However, the potential scope of motor configurations is enormously extensive. With a theoretically infinite number of motor configuration possibilities, it would be impossible with human resources to manually select an optimal combination of motor configurations for a motor platform while accounting for all requirements. Consequently, ZF needed a simulation and data-driven solution that would empower them to consider shared parts, costs, and further constraints to automatically find best configurations for a modular motor platform.

## Our Solution

Looking for a pioneering solution for the complex design optimization challenge, ZF partnered with Altair to implement a data-driven development and optimization strategy for e-motors. Altair is collaborating with leading global automakers to develop the Altair eMotor Director. This highly automated environment is designed to accelerate e-motor development by facilitating multiphysics simulation, rapid design exploration, and optimization based on one or multiple design of experiment (DOE) analyses.

Virtual design exploration and optimization of individual designs are commonplace among motor developers but performing multi-concept and motor platform optimization brings a whole new set of challenges. With theoretically infinite attribute combinations and multiple objective and subjective design constraints within each motor configuration, the optimization engine in Altair eMotor Director needed to accommodate a very flexible definition of the design optimization problem, including the definition of shared and individual motor parameter settings, design variables, and requirements for all members of a motor platform. All these input options and restrictions needed to be presented to the user of eMotor Director in a logical and intuitive user experience, giving the user a clear overview of the project combined with the flexibility to make adjustments throughout the development process.

## Results

The collaborative work of ZF and Altair has resulted in a user-friendly optimization environment capable to handle the complex definition of an e-motor platform design problem. The environment allows the selection of an arbitrary number of Reduced-Order Models (ROMs) to be considered and provides real-time feedback on potential ROMs that might contain possible solutions for each motor of the motor platform. Parameters and requirements can be easily set for each motor individually or linked between two or more motors of the platform. A motor platform optimization yields several feasible motor platform scenarios. The user can afterwards make a suitable selection from these possible solutions.