



Ansys + ZF

“Simulation is among the core elements of digital transformation needed to revolutionize our product development. Ansys' solutions pay off in shorter development cycles and less prototyping — key points in digitizing our R&D processes that help us take our mobility solutions in new directions.”

— **Dr. Helmut Schmid**

Manager, Advanced Development Department / ZF Friedrichshafen AG

/ ZF Leverages Ansys Toolchain to Produce a Competitive, Power-dense Electric Motor Design Running at 95% System-level Efficiency

ZF Friedrichshafen AG is automating development for all characteristics of electric motors related to electromagnetic, thermal, and mechanical domains. The goal is to continuously deliver software solutions and provide novel methods and tools that can be used by stakeholders all along the development chain. ZF looks to Ansys-enabled simulation frameworks and workflows to deliver sustainable solutions to individuals involved in the core development of ZF's electric motor technology.

/ Challenges

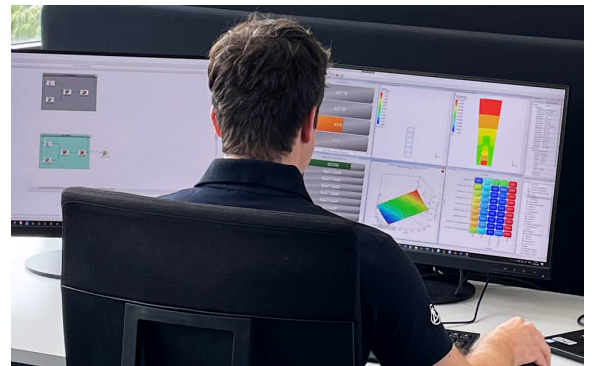
To best address automotive original equipment manufacturer (OEM) requirements, ZF needed to develop electromagnetic technology with a simple functionality that extends to vehicle motion control, integrated safety, autonomous driving, and electric mobility — high-volume, novel solutions available at an affordable cost. Consequently, ZF needed to standardize the development process on both the product side and the simulation side to realize greater efficiencies and continuously deliver solutions, methods, and tools suitable for internal stakeholders at every step. Chaining different multiphysics tools together was of key importance during this process.

/ Ansys Products Used

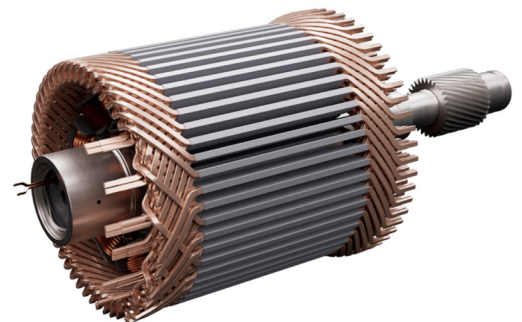
- Ansys Fluent
- Ansys Maxwell
- Ansys Twin Builder

/ Engineering Solution

Ansys simulation made accessible on ZF's local workstation and high-performance compute environments on-premises was used to shorten development times with a high degree of maturity for multiphysics simulations in electromagnetic, thermal, mechanical, and fluid domains. Various Ansys solutions were incorporated into automated workflows with standardized and modular scripts. This enabled the metamodeling needed for analyzing thousands of different designs, with a focus on different properties of the final product to achieve standardization across ZF's entire product portfolio.



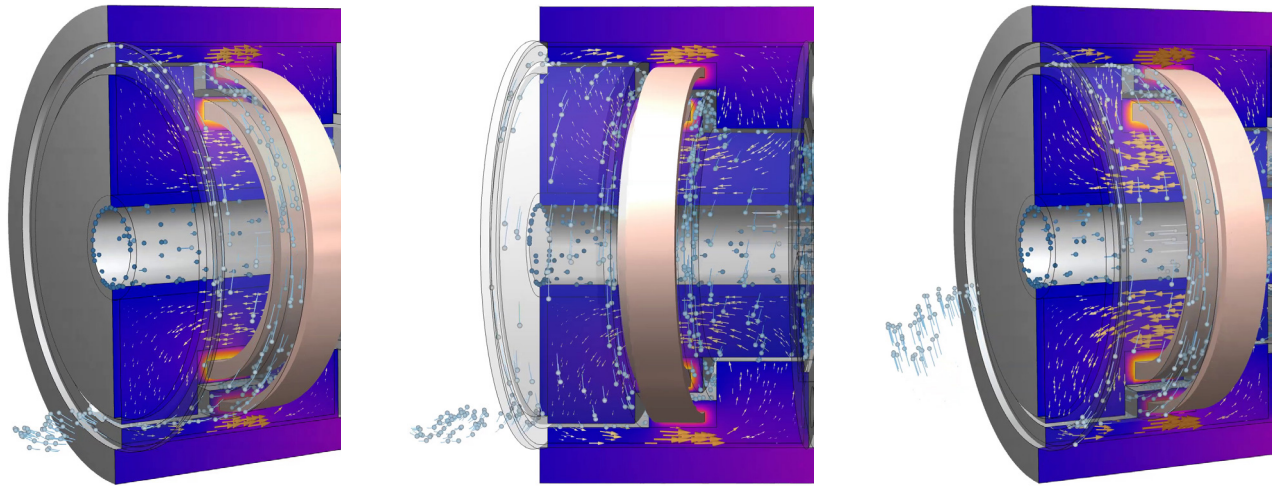
ZF engineer using Ansys software.



World's most compact separately excited synchronous motor: with its I²SM-called concept, ZF develops a sustainable and efficient alternative to common e-motors.



ZF's electric motor is uniquely compact due to its innovative rotor design: the energy for the magnetic field in the rotor is generated by coils whose current is transmitted via an inductive exciter inside the rotor shaft.



Fluid, thermal, and electromagnetic simulation of an inductive exciter unit for ZF's Separately Excited Synchronous Motor.

/ Benefits

- Simulating multiple physics and domains enabled the successful evaluation of thousands of design variants to help ZF produce a hardware prototype that outperforms its current benchmark for power density at 95% system-level efficiency.
- Using Ansys Q3D Extractor in Ansys Fluent to calculate the parasitic effects and frequency-dependent characteristics of their designs as a part of a larger electronic design automation workflow resulted in an accurate model of the circuit needed to simulate circuit response.
- Passing the circuit model through Ansys Maxwell enabled a parametric (statistical) model that could then be further optimized in Ansys Twin Builder via Ansys Electronics Desktop (AEDT) to understand electromagnetic components and their effects on overall design, then create a larger model that could be further optimized to meet all necessary component requirements.
- The resulting Q3D Extractor-Maxwell-Twin Builder workflow currently supports the creation of thousands of design variations that can be benchmarked against outside products for performance, efficiency, compactness, and cost to deliver a competitive yet simple electric motor solution.
- Ansys simulation also facilitates ZF's "blank canvas" approach to development, enabling the R&D team to freely play in the white space to figure out an entirely new principle reflected in a new product around a serious application for their customers.

/ Company Description

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.

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When visionary companies need to know how their world-changing ideas will perform, they close the gap between design and reality with Ansys simulation. For more than 50 years, Ansys software has enabled innovators across industries to push boundaries by using the predictive power of simulation. From sustainable transportation to advanced semiconductors, from satellite systems to life-saving medical devices, the next great leaps in human advancement will be powered by Ansys.

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