CUSTOMER STORY

Electric Motor Design – Maximizing Performance while Minimizing Cost and Climate Impact

Read about how EDRMedeso's customer, Grundfos, employs state-of-the-art simulation solutions from Ansys to design efficient electric motors.

What are the challenges faced during product development?

When feasible, we use fast simulations models based on analytical equations and empirical tuning, when designing and optimizing e-motors. But, for some novel topologies, our fast analytical tools are not able to predict the motor performance with a satisfying degree of accuracy.

For such tasks, a finite element approach is necessary for the analysis. Previously, this was quite cumbersome to set up, as geometries had to be parametrized, which typically requires a lot of scripting. Furthermore, the solving time and computational resources are very high compared to analytical simulations. And when a wide area of the torque-speed plane is of interest, the finite element approach becomes even more time consuming compared to the analytical simulations.

When the motor design is primarily done by an electrical engineer with analysis mainly within the electromagnetic domain, thermal and acoustic issues can arise very late in the product development process. This leads to delays in product launch, and it is generally very costly and difficult to make the necessary design corrections at this late stage of the development process.

Ansys Motor-CAD has addressed a lot of the above-mentioned challenges, with the following features:

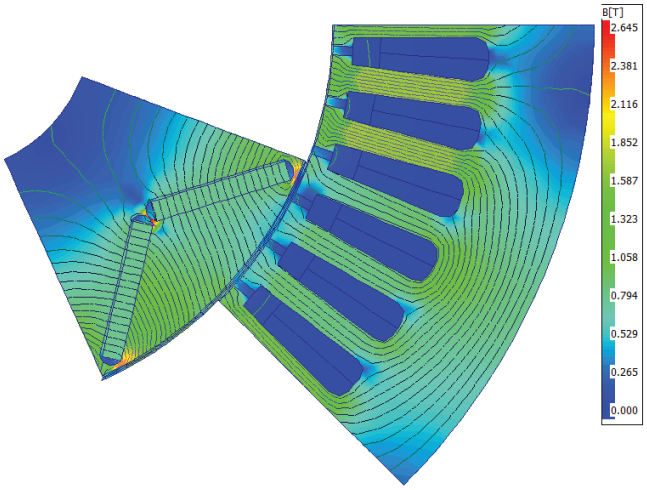
- Large variety of built-in parametrized geometry templates and motor specific analysis and outputs – This makes the finite element approach a lot less cumbersome.
- LAB module (with multicore functionality) for analysis across the motor's full operating

Grundfos

Grundfos is a global water technology company committed to pioneering solutions to the world's water and climate challenges and improving the quality of life for people.
They are one of the largest manufacturers of pumps, and all of these pumps are driven by electric motors.

EDRMedeso

EDRMedeso is the leading supplier in Northern Europe of engineering software - Digital Labs & Cloud Computing. We work with some of the key players in the fields of simulation and computer-aided engineering. We are Ansy's only Elite Channel Partner covering the Nordics and UK.



Flux density distribution in motor (simulated by Ansys Motor-CAD)

range in the torque-speed plane – This approach is A LOT faster than setting up a large number of individual successive simulations through scripting etc.

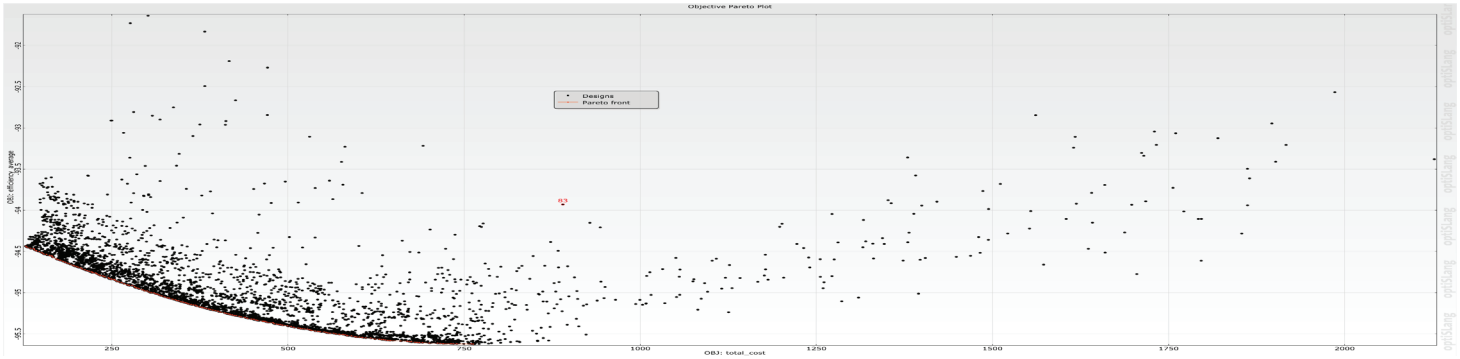
- Built-in thermal and mechanical modules, with an interface that allows electrical engineers to operate it – This allows for a seamless coupling between electromagnetic and thermal models, which increases the accuracy of the analysis. Furthermore, it enables us to extract relevant design trade-offs between electromagnetic, thermal, and mechanical domains early in the development stage.

What are the benefits of simulation for you?

Simulation definitely shortens the development time, as it reduces the number of physical prototypes drastically. Simulations can also enable a very deep level of analysis on e-motors. Thus, it is absolutely crucial in order to maximize performance (efficiency, power density, acoustics) while minimizing cost and climate impact. High fidelity simulations enable us to explore novel designs and ideas without building physical prototypes. Furthermore, the user-friendly interface of the different Ansys tools is effectively democratizing the analysis of e-motors, that was previously much more confined within highly specialized experts.

Which Ansys products do you use?

For e-motor design we use Motor-CAD, OptiSLang and Maxwell. A toolchain comprised of optiSLang and Motor-CAD provides the possibility of applying state of the art optimization algorithms to high fidelity simulations. The option for ratio-based geometry parametrizations secures minimal number of invalid geometries requested by the optimization algorithm.



Motor optimization results (simulated by Ansys optiSLang)

The meta-model functionality in optiSLang is very helpful in combining optimization algorithms with numerical solvers, as a direct coupling can be quite tricky.

Maxwell is typically applied for 3D analysis. With the relative new link between Motor-CAD and Maxwell, a full 3D finite element analysis can be generated and solved exclusively from the parametrized and very user-friendly environment in Motor-CAD.

Can you share your company's vision about simulation-based product development?

Simulations will be increasingly more important for the development of e-motors in Grundfos. Multi-physics high fidelity optimizations executed on HPC infrastructure is a core component of the e-motor product development in the future.

Furthermore, a holistic system level optimization is needed that combines reduced order models for different sub-components such as power electronics, e-motor, hydraulics, and cooling system. This is crucial to avoid that sub-components are optimized separately, as it rarely leads to a global optimum on product level.

The simulation models developed during the product development can be further applied in the use-phase of the product as the basis for the digital twin and predictive maintenance. This further solidifies the importance of simulations.