SENSOR ACCURACY DRIVES PERFORMANCE

MODEL-BASED DEVELOPMENT IMPROVES E-MOTOR RELIABILITY AND EFFICIENCY

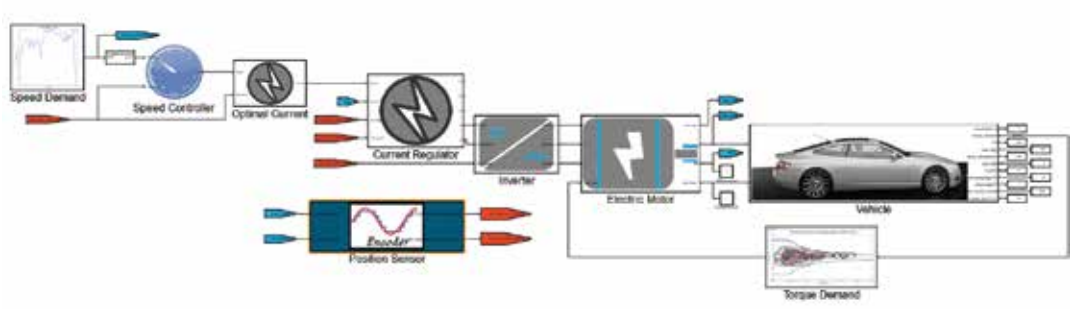
About the Customer

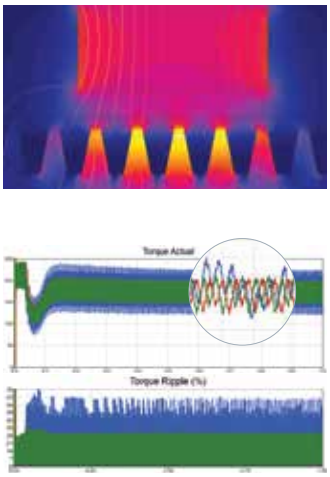
Lenord, Bauer & Co. GmbH is an international specialist in the field of motion sensors and integrated drive technology. The company develops, produces, and distributes technology-leading solutions for the mobility and machinery sectors. Its activities are focused on railway rolling stock, machine tools, and packaging machines. Lenord + Bauer's customers have been benefiting from its considerable technical consultancy skills and expertise in customer applications for more than 50 years.

> "The comprehensive evaluation of sensor accuracy is key for electrically-driven systems and requires an integrated, multi-domain system simulation approach.
>
> Ulrich Marl, Key Account Manager, Automotive
> Lenord + Bauer

Their Challenge

In electric vehicle design, manufacturers and suppliers have a limited supply of energy from the e-powertrain, but customers put a premium on range and reliability. Noise factors also contribute greatly to perceived quality. Additionally, cost must be considered so that vehicles are both profitable for the manufacturers and affordable to the public. Lenord + Bauer needed a way to ensure its sensors were providing high resolution, accuracy, and precision to help powertrain developers design more efficient drive systems. To represent the company's high-accuracy encoders and the e-drive as a whole, Lenord + Bauer needed to combine simulation results in multiple fidelities.





LEFT: The complex powertrain system can easily be modeled in Altair Activate® **TOP:** Model fidelity switching, from equations to ROM and co-simulation enables efficient design. approach. **BOTTOM:** Detailed sensor model can easily be integrate into the system.

Our Solution

Altair's model-based development (MBD) tools simulate complex products as systems-of-systems, allowing e-motor designers to explore sensor design and controls and their impact on powertrain noise and efficiency. MBD combines mechanical models with electrical models and their controller configurations in 0D, 1D, or 3D environments.

A sub-system model was created for Lenord + Bauer to represent the speed controller, which compares desired and actual speed of the motor and generates a torque demand. This data was converted to table format to be used in Altair's MBD tool Altair Activate®. The process was partially automated using the math and scripting software Altair Compose® to convert 3D motor results into a reduced fidelity model suitable for system simulation, which were then linked to the current controller block and to the global model-based system simulation.

Model blocks were also created to represent the inverter and e-motor. Altair Flux™ allowed Lenord + Bauer to produce high-fidelity 3D representations of the e-motor's electromagnetic, thermal, and structural performance. High-fidelity co-simulation was used for the detailed motor design phase and to validate inverter signals, while lower-fidelity equations or table-based models were used at the controller level.

Results

Altair Activate helped Lenord + Bauer combine mixed-fidelity simulation results with its 1D sensor models to execute multi-disciplinary system simulation. They used Activate to both optimize the design of the sensor itself and run comparisons of performance based on sensor positioning. Engineers could easily switch between several sensor types, implemented as 1D diagrams to understand their influence on the whole system. This workflow enabled a 50% reduction in torque ripples compared to conventional resolvers, ensuring greater sensor accuracy.

Lenord + Bauer plans to continue exploring and improving their MBD processes with Altair solutions, allowing them to quickly select and adapt sensor characteristics, increase model reliability, and reduce R&D time.

To learn more, please visit altair.com/activate