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LUCID



case STUDY

Lucid Motors boosts electric vehicle performance with modeFRONTIER

Performing multi-objective inverter cooling system optimization with modeFRONTIER

California-based electric car company, **Lucid Motors**, applies innovative engineering, design and technology to define a new class of premium electric vehicle. Their first **Lucid Air** all-electric sedan, with up to 400 mile range battery options and 1,000 horsepower twin-motor configuration with all-wheel drive, is to be delivered in 2019. In preparation for production, Lucid Air prototypes are undergoing a rigorous development program. **modeFRONTIER** has been used - together with other applications - to optimize the design of an inverter with the aim of enhancing efficiency and minimize failure rates.

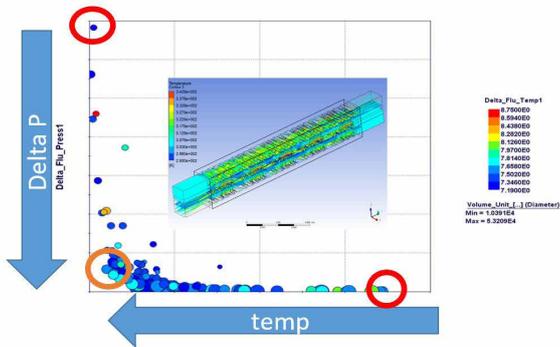
CHALLENGE

An inverter is an electronic device that converts the direct current (DC) stored in the battery into alternating current (AC) and send electricity to the three phases of the AC induction motors. Overheating is the most critical issue beside vibration, humidity and dust when designing a drive inverter for hybrid and pure electric vehicles. Its efficiency is instead driven by low chip-to-coolant thermal conductivity together with temperature balance and low pumping pressure. The Lucid Motors team focused on designing an inverter cooling system that keeps the temperature under control.



modeFRONTIER helped optimize temperature and pressure for our new generation electric vehicle inverter.





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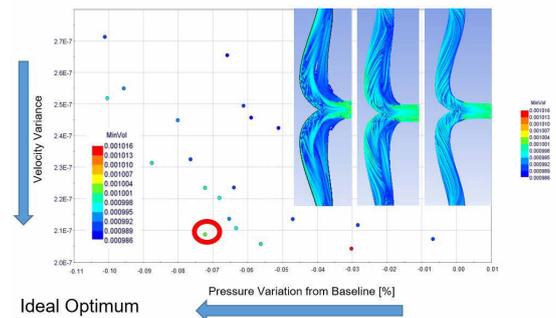
Optimum channel solution for temperature reduction, lowering pressure and minimizing size.

SOLUTION

Starting from the conceptual design of a cooling channel with different configurations, engineers at **Lucid Motors** performed different design of experiments evaluations and sensitivity analysis using a **fully-parametric CFD model with modeFRONTIER**, which enabled them to find optimal design candidates for temperature reduction, lowering pressure and minimizing channel size. “After deciding on an **optimum channel solution**, we went further and optimized the manifold design by including a mesh-morphing step in the **modeFRONTIER** process integration workflow. The objectives there were to keep pressure variations low and reduce velocity variation”, said **David Moseley, Director, Powertrain, Lucid Motors**.

BENEFITS

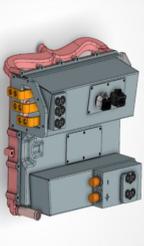
modeFRONTIER provided an environment to identify inverter optimal designs while enhancing efficiency and minimizing failure rates. The use of **modeFRONTIER** enabled Lucid engineers to make more power available to the inverter and increase alternative current from 1200 to 1500A. The **ESTECO** technology also supported the Lucid Air development in optimizing suspension components and enhancing the thermal performance for the motor cooling.



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Optimized manifold design with lower pressure variations and reduced velocity variation.

	Lucid (modeFRONTIER)	Lucid (Gen 4)
Current	1500 A	1200 A
Power	450 kW	350 kW
Power Density	30.0 kW / litre	~39 kW / litre
	29.3 kW / kg	~40 kW / kg



03

Inverter optimization results obtained with modeFRONTIER.

ABOUT ESTECO

ESTECO is an independent software provider, highly specialized in numerical optimization and simulation data management with a sound scientific foundation and a flexible approach to customer needs. With 20 years' experience, the company supports leading organizations in designing the products of the future, today. esteco.com

ABOUT LUCID MOTORS

Lucid Motors is a premium mobility company that is reimagining what a car can be. The company is applying innovative engineering, design, and technology to define a new class of premium electric vehicle. Headquartered in Menlo Park, California, in the heart of Silicon Valley, the Lucid Team brings deep expertise from the automotive and technology industries. The Lucid Air all-electric sedan combines forward-looking design with groundbraking technology to establish an entirely new class of vehicle. Its production will start in 2019 with deliveries taking place shortly thereafter. lucidmotors.com



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