CASE STUDY

Flexcompute and NIO Redefine the Future of Aerodynamics in EVs







ABOUT NIO

Founded in 2014, **NIO Inc. (NYSE: NIO)** has rapidly emerged as a global leader in the smart electric vehicle (EV) industry. Guided by its mission of **"Blue Sky Coming,"** NIO is dedicated to building a more sustainable future through innovative design and advanced technology.

The company's commitment to excellence is reflected in its impressive lineup of vehicles most notably the **ET7 sedan**, with an ultra-low drag coefficient of **0.208**, and the **EC7 coupe SUV**, which leads its class with a Cd of **0.230**. These aerodynamic milestones not only elevate performance but also play a vital role in improving energy efficiency and extending vehicle range. As part of its drive for innovation, **NIO has partnered with Flexcompute** to push the boundaries of aerodynamic optimization using high-fidelity computational fluid dynamics (CFD). By leveraging Flexcompute's **GPU-native solvers**, NIO is able to accelerate design iteration, fine-tune airflow, and further reduce drag– enhancing both performance and sustainability.

Together, NIO and Flexcompute are redefining what's possible in electric mobility—where advanced simulation meets inspired design.



BACKGROUND

In the fast-paced world of electric vehicle (EV) development, NIO (NYSE: NIO), a global leader in smart EVs, was faced with a significant challenge: traditional computational fluid dynamics (CFD) simulations were too slow, requiring hours—or even days—to evaluate each design iteration's impact on drag and aerodynamic performance. To overcome this bottleneck, NIO turned to Flexcompute's revolutionary Flow360, a GPU-native CFD solver that has drastically changed the way they approach aerodynamic optimization.

The Power of GPU in CFD: Transforming Aerodynamic Design

The industry-leading speed of our GPU Native solver has revolutionized the way NIO engineers optimize vehicle aerodynamics. Unlike traditional CFD, where engineers would have to wait hours or days for each simulation, Flow360 can deliver results in seconds. This allows NIO to explore tens to hundreds of design concepts in a single day—an achievement previously impossible with conventional simulation methods.

HIGH-FIDELITY CFD SIMULATION WITH FLOW360

Flexcompute's Flow360 solves the speed and precision problems traditionally associated with CFD simulations. By harnessing the power of GPU-native technology, Flow360 performs simulations up to 10-100 times faster than legacy methods while maintaining the accuracy needed for fine-tuning aerodynamics. NIO has used Flow360 to conduct over **60 fully validated simulations** across various vehicle types, confirming that the platform provides robust results in a wide range of aerodynamic scenarios. This validation proves Flow360's reliability and its ability to deliver real-world insights that align closely with physical testing, such as wind tunnel data.

Key Differentiators of Flow360:

- Fastest Speed and Efficiency: Flow360's simulation time is 10-100 times faster than traditional methods, completing complex simulations in just an hour on 8 L20 (10 mins on 8 H200)
- Unparalleled Accuracy: More than 94% of simulations show less than 3% deviation from physical wind tunnel tests, ensuring that design decisions are based on reliable data.

The results below confirm that Flow360 demonstrates significantly greater robustness and consistency across extensive test scenarios.

Fully validation for more than **60 cases** on different vehicles at NIO:

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The results confirm that our solver demonstrates significantly greater robustness and consistency across extensive test scenarios



Cost Reduction:

For a given hardware investment, NIO is able to get more simulation results due to the fast speed and better scalable code. On average, it sees 60% cost reduction per simulation run. At the same time, high accuracy reduces the need for costly and time-consuming physical prototypes, cutting down on both R&D costs and development timelines.

VEHICLE AERODYNAMICS VALIDATION

Full validation for more than 60 cases on different vehicles at NIO:

 Industry Leading Accuracy: More than 94% of the Flow360 simulation cases have a deviation of less than 3% compare with test data.

Significant simulation speed improvements:

10 Hours

Flow360 was 10 times faster than current simulation process, finish simulation within 1 hour on 8L20 (5 mins on 16 H200)

More Accurate

Substantially Faster Speed

(% of Cases <3% Deviation from Test Data)

Improvement 120x Improvement </t

Cd Correlation Plot (Flow360 vs. Test)



AUTOMATIC PRE/POST-PROCESSING FOR END-END SOLUTION

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Automatic post-processing and report generation within 20 minutes

*T*FLEXCOMPUTE | **FLOW360**

EASILY CREATE REPORTS



Above: Automatic volume mesh generation



Above: Flow360's fully automatic post-processing and report generation





AERODYNAMIC & AEROACOUSTIC SIMULATION IN ONE PLATFORM

Predicting and managing NVH is a major challenge for Automotive OEMs, as consumers expect quieter vehicles as a mark of quality. This demand is amplified by the rise of EVs, where near-silent powertrains make wind noise a key concern. Flow360 addresses this with a high-fidelity, low-dissipation solver featuring built-in FWH, enabling accurate aeroacoustic predictions. Accurate aeroacoustics requires solid aerodynamics, so Flow360 lets aerodynamicists and NVH engineers collaborate seamlessly using one solver. The figures below validate Flow360's ability to match physical test data for driver side-glass pressure fluctuations—a key input for cabin comfort.

High fidelity compressible transient simulation:

- High Accuracy: Pressure Spectrum at side glass match with test data very well up to 10000 Hz.
- Detailed Flow Field: Flow360 captured very detailed vortex generation and cascade

Pressure Spectrum @ Side Glass Front Location

- Test
- FLOW360



Above: Q criterion Iso-surface around side glass



Pressure Spectrum @ Side Glass Rear Location

— Test

— FLOW360



IMPACT ON NIO'S DEVELOPMENT

Flexcompute's Flow360 has allowed NIO to accelerate its design cycles, enhance vehicle performance, and streamline its product development process. With Flow360's speed and accuracy, NIO can now develop smarter, more sustainable vehicles, bringing innovation to the forefront of electric mobility.

Key Outcomes for NIO:

- Accelerated Development: Faster simulation times have enabled NIO to shorten R&D timelines, bringing new models to market more quickly.
- Enhanced Vehicle Performance: Optimized aerodynamic designs lead to better energy efficiency, longer range, and superior driving dynamics.
- **Streamlined Decision-Making:** Flow360 provides faster insights and better data-driven decisions, leading to the optimum design faster.

"In NIO we strive to be pioneers in technologies not only for our products but also for the engineering tools and processes. With this spirit it was just natural to partner with FC for the application of GPU in CFD simulations. After extensive validation, I am very impressed by the speed and accuracy of Flow360. The CFD solver has produced consistently accurate results vs our Wind Tunnel experiments on a variety of vehicle types from small sedans to large SUV's. What used to take hours or days to solve is now done in minutes. With this level of accuracy and speed we can make decisions faster and reduce our overall product development time. Flow360 is becoming an integral part of our future product development plans."



DANILO TEOBALDI Principal Chief Engineer Head of Advanced Technologies

A HOLISTIC, END-TO-END SOLUTION FOR AUTOMOTIVE CFD SIMULATION



Unified, Multi-Fidelity, Multiphysics Platform

PIONEERING THE FUTURE OF EV DESIGN

The collaboration between NIO and Flexcompute is setting new standards for aerodynamic simulation in the automotive industry. This partnership has empowered NIO to design vehicles that are not only high-performing but also optimized for sustainability and energy efficiency. As NIO continues to innovate and lead in the smart EV market, Flexcompute's Flow360 plays a critical role in shaping the future of automotive design—one that embraces high-performance computing and rapid innovation.

ABOUT FLEXCOMPUTE

At Flexcompute, innovation is not just a principle—it's the foundation of everything we do. Born from the minds of engineers at MIT and Stanford, we push the boundaries in GPU-native simulation technology. We enable teams to innovate faster, reduce costs, and minimize risks—bringing better products to market faster. Our mission is to make hardware innovation as easy as software.

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