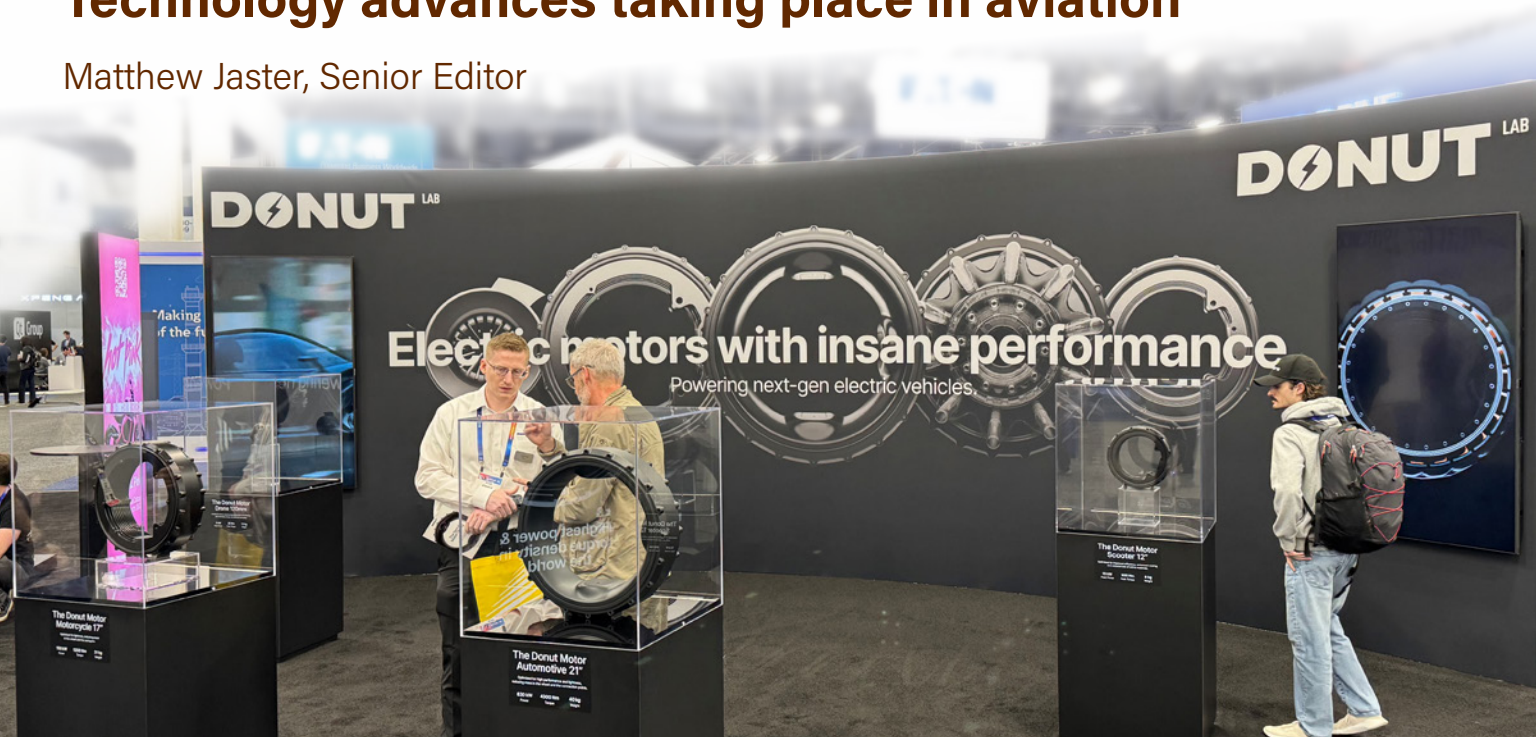
Aerospace Motor Market Trends

Technology advances taking place in aviation

Matthew Jaster, Senior Editor



Donut Lab presented its innovative platform of motor technologies at CES 2025 in Las Vegas.

The trade show circuit has offered a wealth of e-mobility and motor technologies recently. From IMTS and Pack Expo to MINExpo and CES 2025, there are plenty of disruptors in the motor segment for power transmission components. One area—in particular—is the aerospace industry where vertical takeoff and landing (VTOL) rotorcrafts continue to redefine aerial transport, variable frequency drives (VFDs) support aircraft performance, stepper motors provide passenger comfort and software enables engineers to optimize electric motor design.

Donut Lab Adds Innovation to VTOL Technologies

HyperQ Aerospace is reshaping the landscape of VTOL rotorcraft with their innovative RotorHawk—a remotely piloted heavy-lift craft designed for high-speed and complex missions. By harnessing Donut Platform's motors and modular architecture, HyperQ unlocks new capabilities in range, payload, and flexibility.

The Donut Platform enables HyperQ to create long-range, heavy-lift drones with exceptional payload capacity, maintaining peak efficiency without sacrificing agility. This advanced propulsion and modularity provides the torque, power, and precision needed for diverse missions, from confined urban logistics to challenging off-grid operations.

This technology was on display recently at CES 2025 where Donut Lab's engineering team discussed how this electric motor technology could redefine aerial transport.

In addition, the motor family can deliver high-precision control required for robotic motion capabilities ensuring robotic systems operate seamlessly, executing tasks with required accuracy and fluidity.

Powered by "The Brain," the Donut Platform brings computing capabilities tailored specifically for AI-driven robotics. This next-generation control unit allows robots to process and adapt in real-time, enabling smarter automation, dynamic responses, and advanced functionalities.

The Donut Motor provides exceptional power and torque in a compact design, allowing for more efficient and agile robotic systems. The unique design minimizes mechanical complexity, reducing wear while maximizing responsiveness and performance.

donutlab.com

Portescap Provides Stepper Motors for Environmental Control Systems

Stepper motors play an integral role in ensuring the comfort of airplane passengers. Achieving precise, repeatable control of the crucial electronic expansion valves within an aircraft's Environmental Control System (ECS), these

Portescap stepper motors provide custom design properties suitable for environmental control systems within aircrafts.

motors must also ensure high durability. With customization for design integration also a common requirement, this makes motor specification a crucial stage in the development of an aircraft's ECS.

Within an aircraft cabin, an ECS is essential, both for safety, as well as the comfort of passengers and air crew. This technology regulates the pressure and temperature within the cabin, and integral to the system are the valves that control airflow. Particularly for the management of air conditioning and refrigeration, the electronic expansion valve (EEV) is key. With the role of precisely controlling refrigerant flow, these valves enable efficient temperature regulation onboard.

An electric motor actuates the electronic expansion valve via signals received from the ECS controller, which monitors cabin temperature. The motor drives precise valve regulation to control refrigerant flow into an evaporator. While the evaporator is fed by air from outside the aircraft, which is heated by compression or through bleed air from the engine, the blend of refrigerant balances air temperature within the cabin.

The advantage of an electric motor and controls is variable modulation, and it's this flexibility that is crucial to fine-tune refrigerant flow and optimizes passenger and crew comfort. The motor must be able to achieve the required level of precision, and stepper motors are the typical choice. This motor design opens or closes the expansion valve in small, controlled steps; these increments are measured in fractions of a degree, dependent on the resolution of the motor, and this adjustment achieves precision in valve control.

Crucially, the stepper motor also ensures repeatable control. Since it moves in discrete steps, with each step corresponding to a fixed angular movement, this enforces its precision. Enhancing control repeatability, a stepper motor also provides the higher torque required for the relatively low speed operation of the valve. This means that the stepper motor can generate sufficient holding torque to maintain its position without losing steps when under pressure of the refrigerant.

Although an aircraft's ECS should include redundancy, protecting against motor failure is vital to minimize the cost and time of maintenance. The design of the stepper motor is inherently durable as it doesn't rely on mechanical brushes to achieve commutation, and neither does it need a feedback device or a complex closed-loop controller. This simplicity also helps secure a lower cost in procurement. However, when selecting a stepper motor, it's essential to ensure it can withstand temperature extremes, including temperatures up to 130°C faced by the evaporator, as well as the low temperatures of the refrigerant.

Low weight and size are also important to improve an aircraft's fuel efficiency and cargo-carrying capability. Stepper motors achieve high torque density for their low-speed operation requirements, and as they don't require complex external electronics or feedback, this advantage reduces the total weight and size of the package.

As part of motor specification, customization might be required, particularly to enhance design integration. Features such as customized mounting plates and output pinions might be necessary, as well as modifications to the motor itself. Partnering with a micro motor manufacturer like Portescap that provides customizable, off the shelf designs, as well as fully tailored motion solutions, is beneficial. This approach not only minimizes the time and cost of internal development, but the experience in motor customization helps to ensure performance and reliability is maintained.

portescap.com

ABB Optimizes Motors, Generators and Drives

ABB has modernized a variable speed drive (VSD) for NASA to extend, by at least 10 years, the life of the wind tunnel at its National Transonic Facility (NTF) at Langley Research Center in Hampton, VA. The tunnel is used to optimize aircraft performance and fuel consumption by mimicking flight conditions at high altitudes and close to the speed of sound. It has been used to test the Boeing 777, the Space Shuttle and its Booster Rocket.

In 2021, NASA's engineers identified a need to upgrade the tunnel's medium voltage (MV) drive, due to the aging of the drive's components. ABB supplied the drive in 1997 as the most powerful of its kind in the world: the 101-megawatt (MW) drive can test models in air or nitrogen flowing at transonic speeds and at ambient or cryogenic temperatures. As a result, the NTF can simulate a wider range of flying conditions than any other wind tunnel, enabling engineers to gain unique insight and hone aircraft designs.

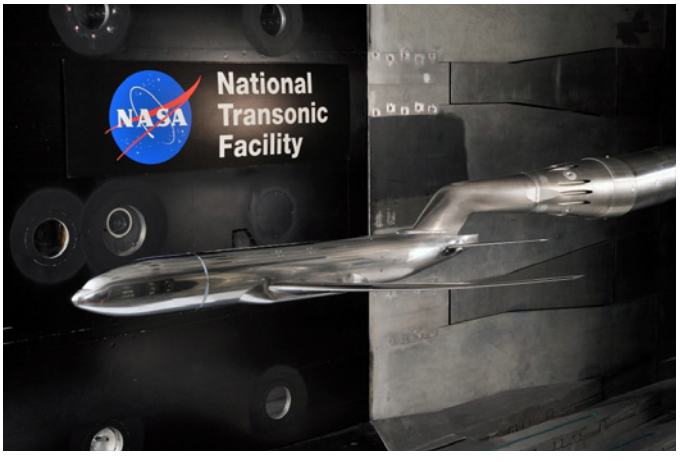


ABB recently modernized a VSD for a NASA Research Center.

After ABB's service specialists evaluated the performance and mechanical connections of the existing drive, the next step was to develop a solution based on modern high-efficiency power electronic components to match the original drive's maximum power, while achieving high availability and reliability. This resulted in the modernization of the drive, replacing key components inside the existing footprint with the latest ABB state-of-the-art technology. The scope included upgrading the small part of the drive (control unit), which minimized the duration and disruption of the project and demonstrated circularity by minimizing waste and logistics as much as possible.

"NASA relied on ABB's domain expertise, technology and services to ensure its National Transonic Facility (NTF) provides high reliability and uptime to maximize availability for its testing programs—and optimize the life-cycle value of its assets," said Oswald Deuchar, head of modernization services, ABB Motion. "Extending the life of the wind tunnel by at least 10 years supports NASA's operational goals while upgrading the drive's key components demonstrates efficiency and circular approach."

NASA ordered the upgrade project as the first activity under an ABB Motion OneCare service agreement that also covers spare parts and maintenance. This type of agreement provides flexibility for operators like NASA to bundle together the services they want so that they can optimize the life cycle of their motors, generators and drives.

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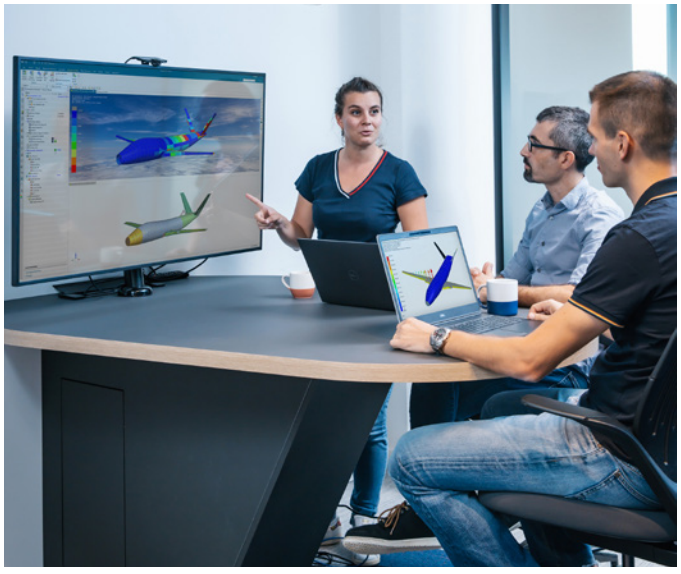
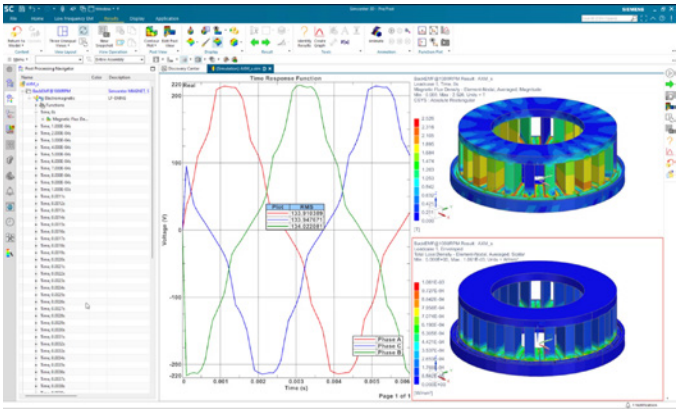
Siemens Software Highlights Motor and Gear Optimization



Software advancements in Siemens* Simcenter *provides motor and gear system support from a design perspective.

Siemens Digital Industries Software recently updated its *Simcenter* portfolio, delivering advancements in aerostructure analysis, electric motor design, gear optimization, and smart virtual sensing. These enhancements are designed to streamline workflows, accelerate certification, and provide deeper insights into system performance.

"These updates empower engineers to meet the evolving challenges of electrification and advanced air mobility," said Jean-Claude Ercolanelli, senior vice president, simulation and test solutions, Siemens Digital Industries Software. "We're delivering tools that drive innovation, improve efficiency and support a more sustainable and connected future."



Simcenter ***enables design and simulation of axial flux motors in a single workflow.***

Simcenter enables faster design and simulation of compact, high-power-density motors with axial flux motor simulation. Engineers can quickly create lightweight designs using Siemens' *Simcenter E-Machine Design* software, then transition seamlessly to 3D simulations in Siemens' *Simcenter* 3D software for comprehensive electromagnetic, thermal and mechanical performance assessments.

In turn, the latest software update introduces gear design optimization where engineers can utilize lightweight gear blank parameterization and an optimization framework to improve gearbox noise, vibration and harshness (NVH) performance. These tools help reduce late-stage design changes and streamline the development cycle.

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