

THE VIEW FROM ABOVE AND BEYOND



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Aerospace and defense companies have much in common: the complexity of products they produce, the harsh environments in which these products operate, and an overriding focus on safety and reliability. However, the commercial aircraft, space and defense sectors each face unique technical challenges and market trends. In this special issue of *ANSYS Advantage* focused on aerospace and defense, we explore how these trends drive technology innovation along with how leading companies leverage pervasive simulation to get products to market faster and increase market share.

COMMERCIAL AVIATION

The commercial aviation segment faces constant pressure to reduce both cost and time to design, produce and maintain aircraft. Simultaneously, regulatory agencies demand improvements in fuel economy, emissions and noise control. In response, commercial aviation companies, along with academic engineers who perform research in this field, are making significant investments to improve performance of engines and the entire aircraft. For example, the University of Nottingham's Institute for Aerospace Technology brings together more than 400 researchers working on 70 projects that explore more electric and green aircraft. To reduce the drag effect of antennas that protrude from the surface of an aircraft and save fuel, Inatel and Embraer embed antennas into the plane's composite structures. This effort incorporates aerodynamics, but also includes a true multiphysics exploration that involves mechanical and electromagnetic

phenomena analysis to ensure that the antennas can transmit and receive signals through the composite shell without sacrificing communications efficiency.

Weight reduction using new materials and production methods is another way to achieve aircraft efficiency. Carbon Freight, a Pittsburgh startup, designed cargo pallets that are 18 percent lighter than traditional aluminum pallets by employing composite simulation to guarantee durability and performance. Through simulation and additive manufacturing, Optisys reduced large multipiece RF antenna assemblies into a single compact part. This decreased the volume of the assembly by a factor of 100, reduced its weight from pounds to ounces, cut product development time and saved the company greater than 50 percent per system in costs. Such reduction in volume and weight is especially important for space applications and drones.

Competition to capture the growing number of air travelers also means an increased focus on passenger comfort. Aircraft climate control experts at Tianjin and Purdue universities employed systems-level simulation and detailed thermal analysis to improve performance of an entire environmental control system.

The aerospace giant Airbus employs simulation to manage and integrate the increasingly complex, distributed smart systems that comprise the modern jet aircraft. Hindustan Aeronautics and many others save money and time by incorporating simulation and automatic coding into the regulatory certification process.

Pervasive simulation unleashes the power of simulation throughout the product lifecycle, not just during the design phase. As part of maintenance, repair and overhaul (MRO) support services, Lufthansa Technik AG simulates the wear and tear of aircraft components, particularly in jet engines, to prolong service intervals and to create new ways to repair used parts.

DEFENSE

While striving to deliver a technological edge in the least amount of time, many defense organizations and their suppliers operate on the principle of "design for affordability," which focuses on simplifying systems, standardizing components across a platform and using COTS (commercial off-the-shelf) components without sacrificing quality and durability. Governments today invest in a modern warfare environment that includes initiatives like C4ISR (command, control, communications, computers, intelligence, surveillance and

reconnaissance), autonomous systems, hypersonic weapons and stealth fighters. These systems are highly dependent on electronics that must perform in harsh environments and tough conditions. Simulation helps engineers understand how failure can occur and how to prevent it. As an example, Kontron uses sophisticated thermal simulation to balance size, weight, power and cooling trade-offs to meet demanding military specifications for mobile and interconnected surveillance, communication and operational devices.

Engineering for sustainability and optimizing operational availability of assets is critical for the defense community. The United States Air Force used simulation to solve a multimillion-dollar issue that occurred when towing aircraft from the maintenance shed to the hangar to the taxiway. Finite element analysis also helped to improve the design of a maintenance trainer for a tracked combat vehicle.

SPACE

After several decades of relative dormancy, the space industry is again a vibrant and growing segment. Previously, well-established incumbents like government agencies and their prime contractors focused on a small number of government and defense contracts, resulting in little incentive to innovate. Now this paradigm has been disrupted by a diverse collection of new entrants and startups. The new space industry is market-driven and supported by private investors interested in rapid technology development for the masses by driving down costs and delivering profitable returns.

New players like Vector leverage simulation to design smaller rockets for more frequent launches, all to make deploying microsattellites routine and affordable. This pushes existing players to modify their design approach to include much more virtual testing, in addition to physical test rigs. Airbus DS performs fluid-structure interaction simulations to solve the problem of fuel sloshing and investigates the effectiveness of a proposed elastomeric membrane in a spacecraft's fuel tank. Innovative companies like World View Enterprises design special vehicles to bring payload up to 95,000 feet and keep it there for weeks or months, reducing cost and deployment time by eliminating the need for a launcher.

Explore this special issue to discover the many ways that simulation is helping to revolutionize the aerospace and defense field. We hope to tell your story next. 🚀