



CONNECTED AIRCRAFT EXPERIENCE

Accelerate Antenna Design, Placement, and Interference Mitigation

THE CONNECTED AIRCRAFT EXPERIENCE



The connected aircraft is transforming the way we communicate on and with an aircraft.

- It makes flights safer by upgrading air traffic management systems.
- It allows for predictive maintenance.
- It improves fleet management, flight operations, and aircraft turnaround time.
- Finally, it reduces operational costs and offers more passenger entertainment.

Among other technical solutions, the connected aircraft relies on seamless high-speed connectivity in the sky. Wireless technology is one of the backbones of high-speed connectivity. It helps enable radio links between aircraft, drones, satellites, ships and ground stations. Installed antennas are key elements in establishing wireless links.

INCREASING CONNECTIVITY CHALLENGES

High-speed data links in aerospace rely on 5G satellite communication in the Ka-band. New classes of antennas are required, operating at higher frequencies. The connectivity technology integrators of aircraft and spacecraft have to ensure the reliable operation of installed radio systems connected to antennas for communication, navigation and surveillance.

Designing antennas and their integration on aircraft and spacecraft is a challenging task:

- Antenna requirements must be met
- Installed antenna performances must be satisfied
- Connected radios must work without degradation

POWER OF THE 3DEXPERIENCE PLATFORM

Electromagnetic (EM) modeling and simulation on the **3DEXPERIENCE**® platform is transforming antenna design, placement and integration workflows. Read this ebook to discover the connected and comprehensive solution for EM simulation.

SIMULATION ON THE 3DEXPERIENCE PLATFORM

Why use the 3DEXPERIENCE platform for antenna design, placement and integration?

The **3DEXPERIENCE** platform offers a real-time view of business activity and ecosystem, connecting people, ideas, and data in a single collaborative environment that empowers businesses and people to innovate in entirely new ways:

- The **3DEXPERIENCE** platform provides a single geometric modeler, user interface, IO and security model.
- Modeling, simulation and manufacturing applications are all on one platform. There is a digital thread between all stakeholders and information can be exchanged without the need to export and translate files.
- In this digital environment, there is a single source of truth. Changes are communicated to everyone, cascading in real-time, across all applications.
- This eliminates the error-prone traditional file-based siloed approach and results in extensive cost savings in product development and risk reduction in physical prototyping.

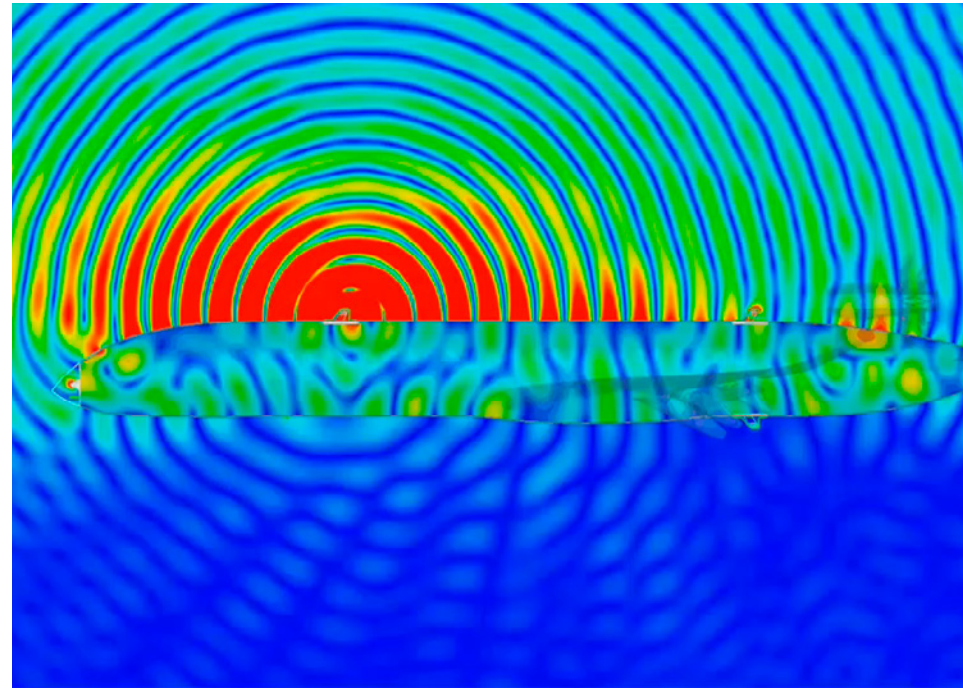


REVEAL AEROSPACE INSTALLED ANTENNA PERFORMANCE

Antenna design, placement and integration all benefit from specialized EM simulation workflows available on the **3DEXPERIENCE** platform. Large multiscale aerospace problems spanning from millimeters to meters have to be meshed and solved often resulting in EM simulation with millions or even billions of unknowns. To solve EM problems, from Low to Super High Frequency bands, the typical aircraft antenna bands, different solvers, ranging from full wave to asymptotic, are deployed.

At Dassault Systèmes we offer:

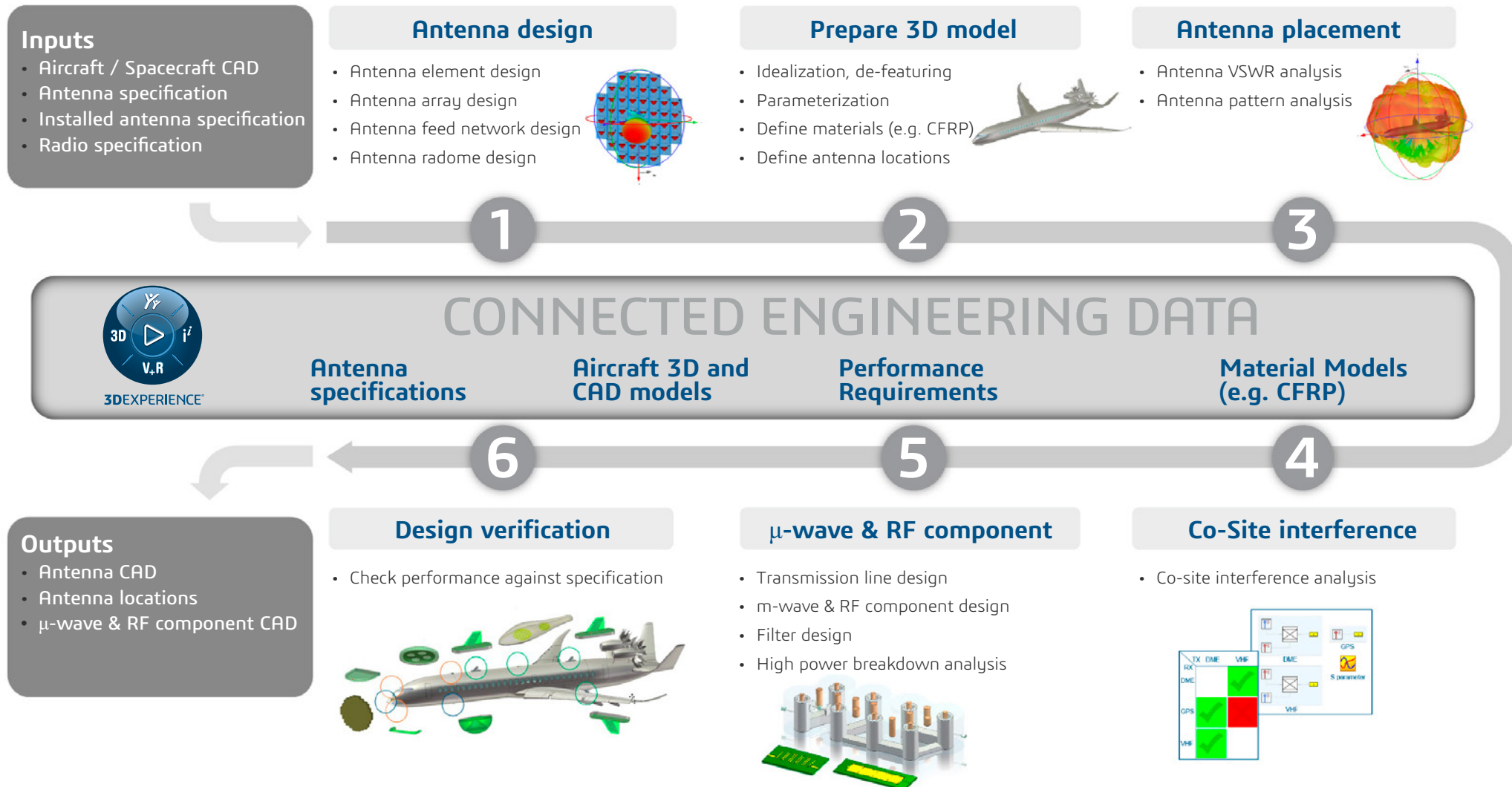
- The most comprehensive EM simulation solver suite on the market and workflows for antenna design, placement and integration.
- Hybrid solutions combining different solvers further extend the application range of our EM simulation offer.
- Access high-performance computing (multithreading, distributed computing, MPI computing, GPU computing) to solve large multiscale aerospace problems faster

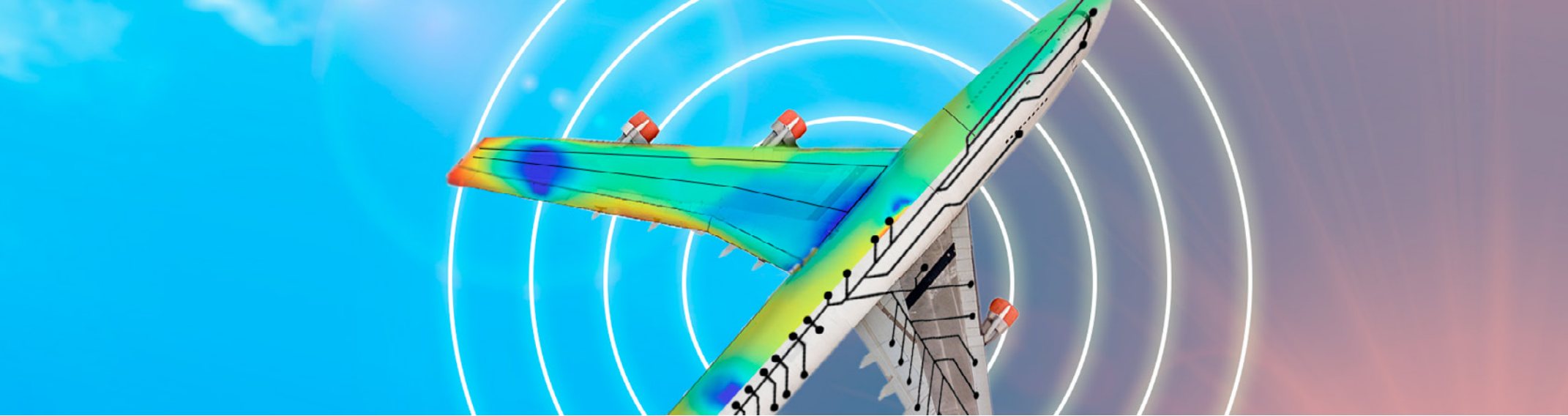


FROM REQUIREMENTS, TO DESIGN, TO SIMULATION, TO MANUFACTURING

Antenna Design, Placement and Interference Workflow

EM simulation workflows on the **3DEXPERIENCE** platform will accelerate the antenna product development by connecting data and processes from requirement to manufacturing. The image shows a comprehensive list of workflows and sub-workflows done at various stages in the design process. It depicts the complexity and the need for a unified system.



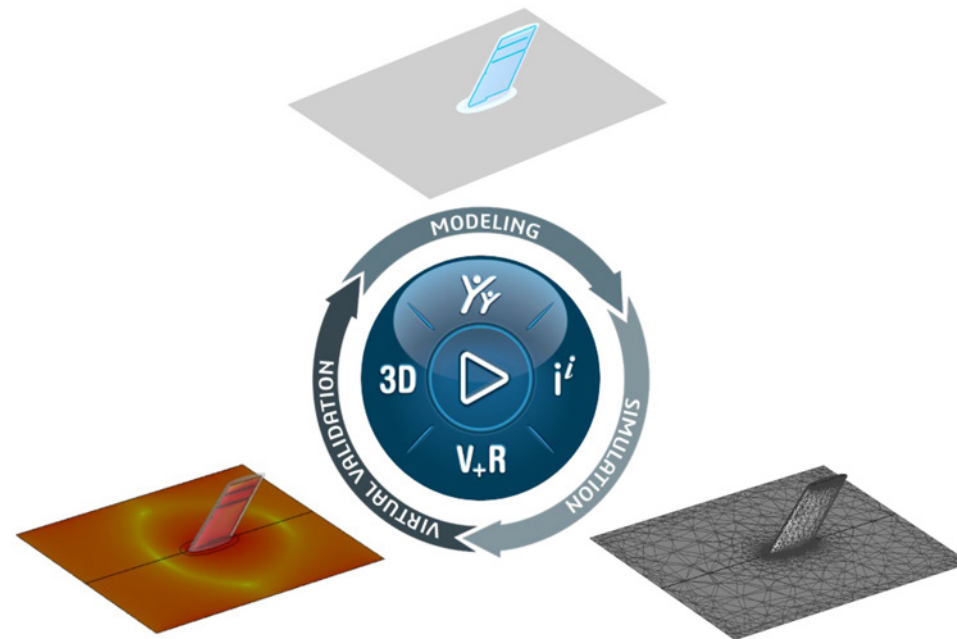


UNIFIED MODELING AND SIMULATION (MODSIM)

Complex workflows require the 3D model to be up-to-date at all times. The **3DEXPERIENCE** platform has been built from the ground up with unified modeling and simulation at its core.

3DEXPERIENCE platform transforms modeling and simulation from a linear to a circular process, and helps:

- Shorten development cycles,
- Reduce costly mistakes and rework and
- Obtain certification in less time and lower cost.



WHY SIMULATE?

The connected aircraft relies on wireless technology. The electromagnetic simulation tools from Dassault Systemes empower engineers to design and integrate antennas while mitigating inference long before building expensive prototypes

Visualize and Understand

Understand the product's electromagnetic behavior and gain insights that are not achievable with testing.

First Time Right

Optimize products to meet specifications for first-time right manufacturing.

Less Physical Testing

Virtual testing with simulation reduces the need for physical prototypes.

Cost Savings

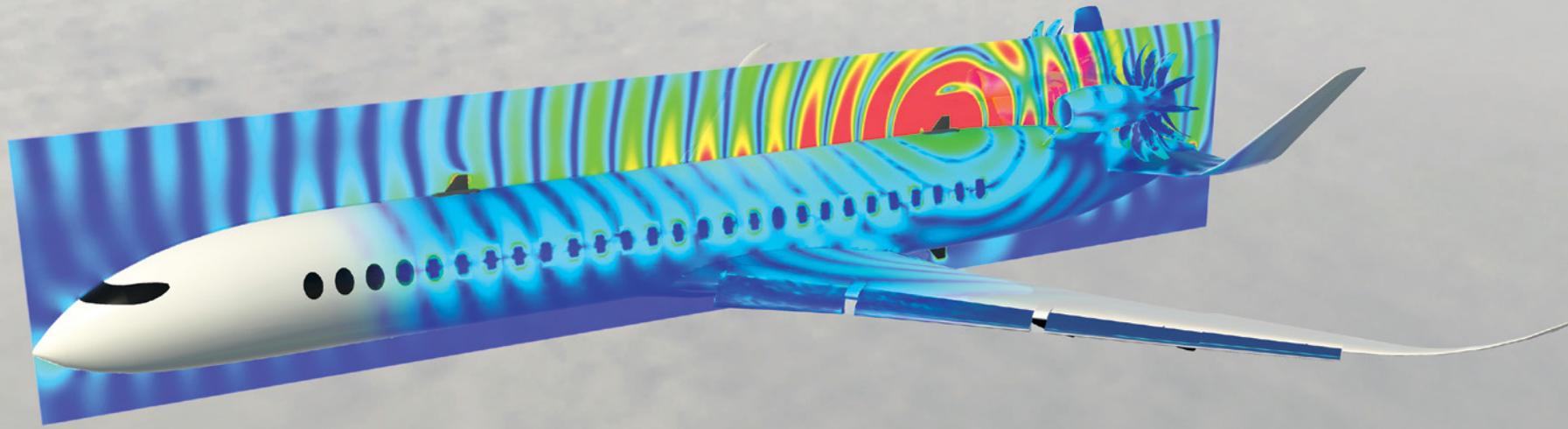
Cut costs and development time using modeling and simulation in **3DEXPERIENCE** platform.

Avoid Risk

Simulate to test and validate installed antenna performance for wider variations than possible with field testing. Be confident in meeting requirements and achieving certification.

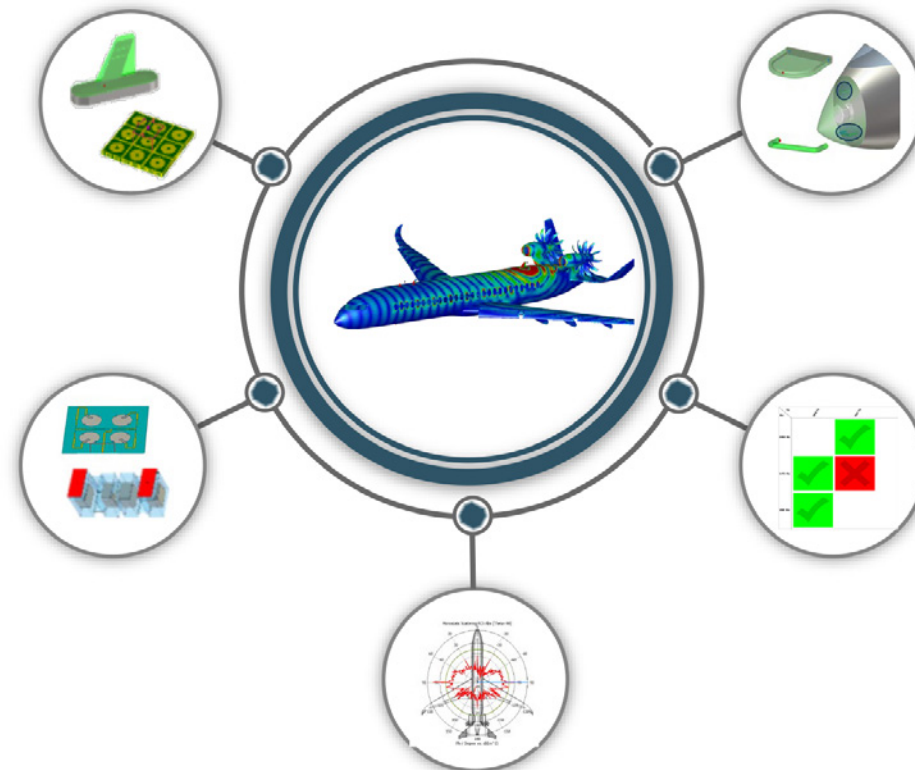
Sustainability

Faster, more accurate innovation and fewer physical prototypes all add up to more sustainable product development, benefiting the business, its people and the planet.



HOW TO SIMULATE?

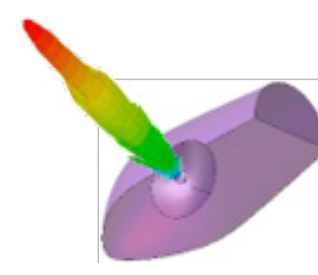
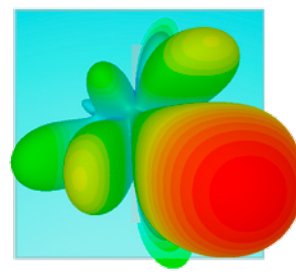
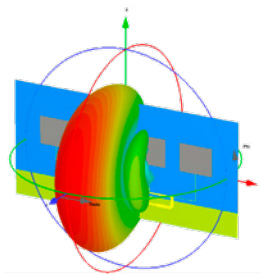
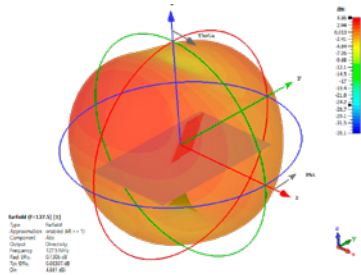
Customers in the aerospace and defense industry are using electromagnetic simulation from Dassault Systèmes for antenna design, placement and integration. These simulation workflows have several sub-workflows and tools. Antenna design comprises—Antenna element design, Antenna array design, Antenna radome design, and Antenna feed network design.



ACCELERATE ANTENNA MODELING AND DESIGN

Invaluable workflows for antenna engineers

Dassault Systèmes antenna design workflows offers engineers tools and sub workflows in a unique collaborative environment.



ANTENNA ELEMENT

- Antenna modeling and design with ANTENNA MAGUS.
- Specification based antenna selection.
- Antenna database of more than 350 antennas.
- Validated antenna models can be exported to CST Studio Suite®.

FEED NETWORK

- Circuit modeling and simulation in CST Studio Suite®.
- Physical modeling with System Assembly and Modeling.
- Simulation, optimization, and post processing with simulation tasks

ANTENNA ARRAY

- Antenna array setup with the CST Studio Suite® array task.
- Unit cell simulation for rapid antenna design.
- Accurate finite array simulation.

RADOME DESIGN

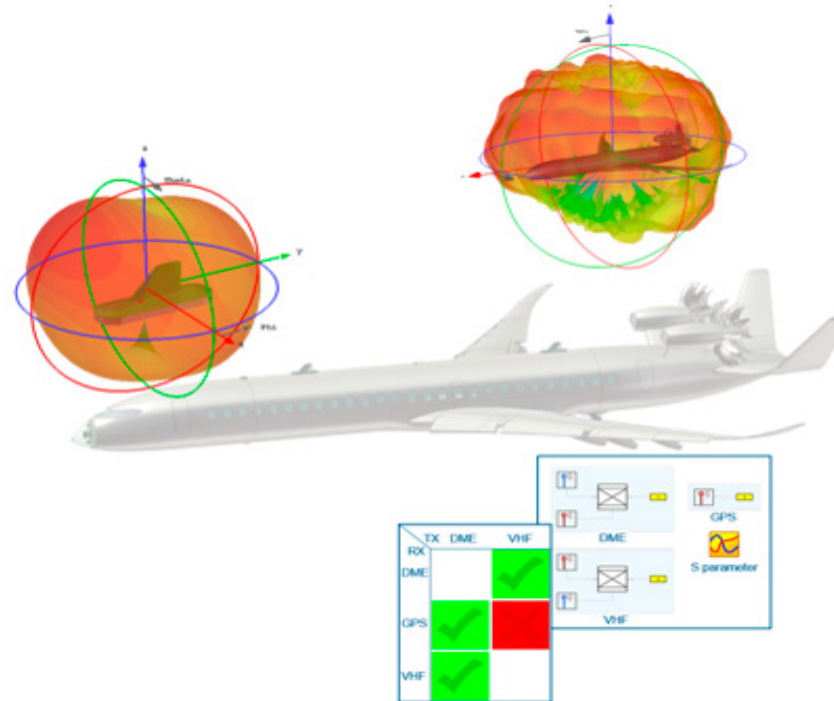
- CST Studio Suite® to model thin and thick multilayer radomes.
- Unit cell simulation for rapid radome optimization.
- Equivalent material models to reduce numerical efforts.

MEETING SPECIFICATION OF INSTALLED ANTENNAS AND RADIOS

Key workflows to achieve antenna performance and to mitigate co-site-interference issues

Installing antennas on platforms like aircraft and spacecraft can be a challenging task. Antennas are designed under ideal conditions and the presence of a platform often degrades the antenna characteristics namely the input impedance and radiation pattern. To complicate the placement task, antenna-to-antenna coupling needs to be minimized to avoid radio malfunctions due to co-interference.

With electromagnetic simulation from Dassault Systèmes, antennas can easily be designed and placed under realistic conditions due to the collaborative nature of the **3DEXPERIENCE** platform. Co-site-interference simulation lets engineers analyze the potential interference of installed radios. Filter synthesis and simulation tools allow the designing of filter solutions to mitigate interference and meet specifications.



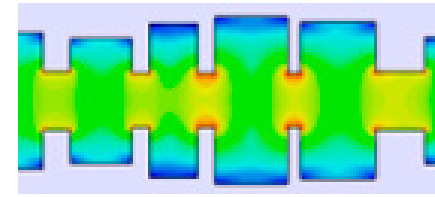
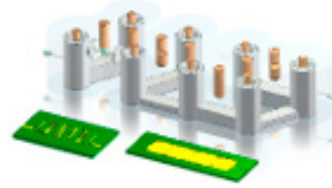
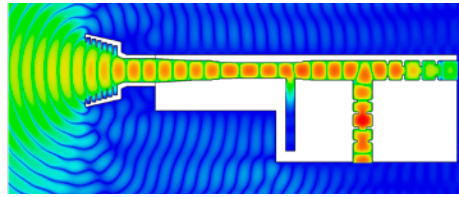
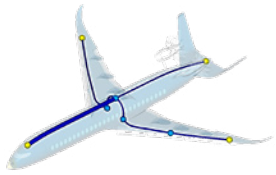
WORKFLOW

- Installed antenna performance
- Co-site interference analysis
- Filter design

ADVANCED MICROWAVE & RF COMPONENT DESIGN

Easy, efficient, and optimal workflows for accurate design

Dassault Systèmes microwave and RF component design workflows offer engineers tools in a unique collaborative environment.



TRANSMISSION LINE

- Cable harness modeling and simulation.
- Collaborative workflow CATIA Electrical—CST Studio Suite®.
- Circuit modeling and simulation of printed lines and waveguides.

MW/RF COMPONENT

- Specialized waveguide synthesis tool Fest3D.
- Waveguide component modeling and simulation in CST Studio Suite®.
- Easy model set up with System Assembly and modeling.
- Multiphysics simulation for thermal and structural analysis.

FILTER

- Advanced filter synthesis tool Filter Designer 3D.
- Building blocks to assemble complex filter models.
- Efficient optimization and hardware tuning with coupling matrix extraction.

BREAKDOWN ANALYSIS

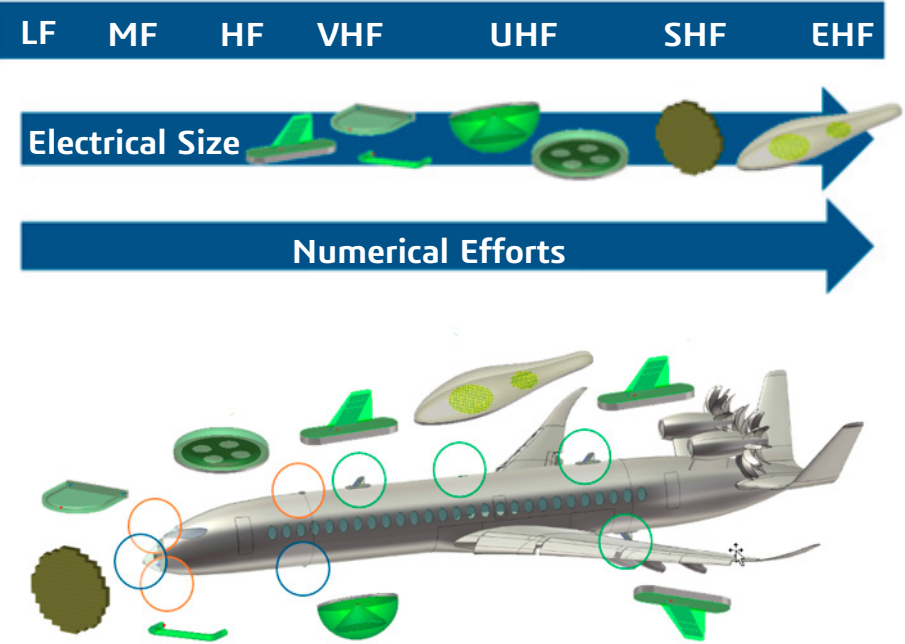
- Specialized solution for space applications.
- Multipactor and corona discharge analysis.
- Reduced risk of problems and over-engineering.

SOLVE LARGE MULTISCALE PROBLEMS

Realistic simulation of installed antenna performance requires solving detail-rich problems of multiple scales, from millimeters to meters, and of large bandwidth. Aircraft antennas operate from low frequencies (LF band) to super high frequencies (SHF band). Ground-to-aircraft communication for instance, happens in the VHF band while SATCOM communication in the SHF band. Solving electromagnetic problems of different electrical size requires multiple solver technologies and faster simulation.

Among the many solvers from Dassault Systèmes, the 3D full-wave time domain is a unique solver. It has robust meshing and Perfect Boundary Approximation (PBA) capabilities to minimize memory requirements and solves broadband problems in a single run. Support for hardware acceleration using GPU and cluster computing makes the time domain solver suitable for large, complex and detail-rich simulations, which would otherwise require unacceptably long simulation times.

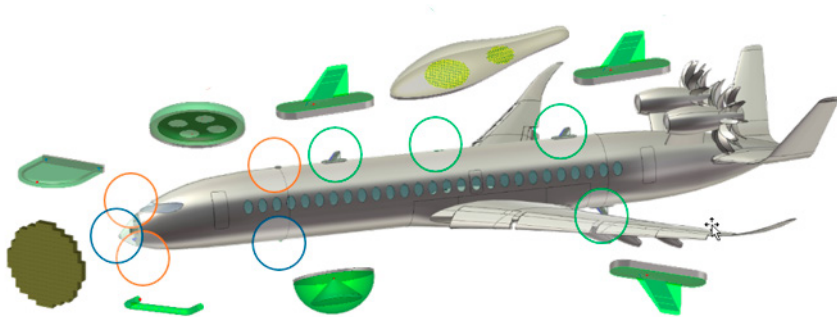
Dassault Systèmes customers can leverage HPC/GPU resources to compute on the **3DEXPERIENCE** cloud for burst computing.



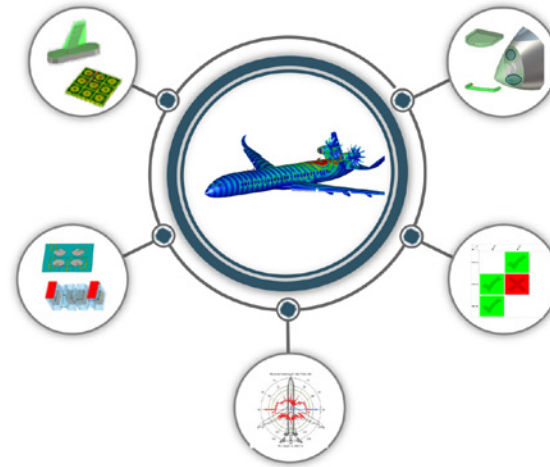
TRANSFORM CONNECTIVITY IN THE SKY

Reduce time and cost with Dassault Systèmes

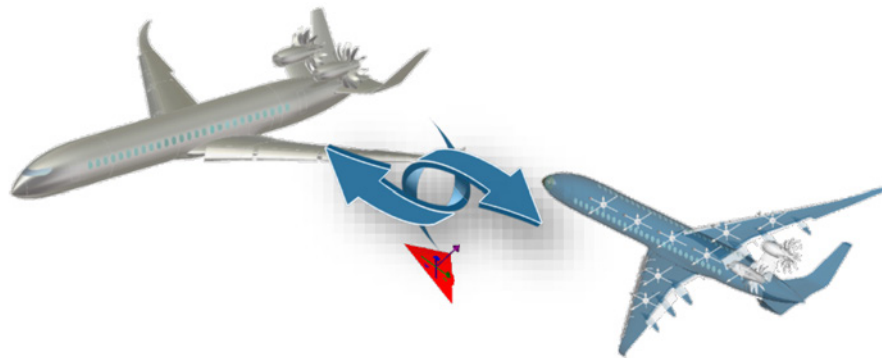
Reveal Aerospace Installed Antenna Performance with best-in-class EM analysis tools



Find the most comprehensive workflows for antenna design, placement, and accurate interference analysis



Manage complexity by working with one single source of truth.



The simulation capabilities are powered by the 3DEXPERIENCE platform to speed up the design process, harmonize data, manage complexity and create a connected workforce.



Greatly improved productivity



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Our **3DEXPERIENCE®** platform powers our brand applications, serving 11 industries, and provides a rich portfolio of industry solution experiences.

Dassault Systèmes, the **3DEXPERIENCE** Company, is a catalyst for human progress. We provide business and people with collaborative virtual environments to imagine sustainable innovations. By creating 'virtual experience twins' of the real world with our **3DEXPERIENCE** platform and applications, our customers push the boundaries of innovation, learning and production.

Dassault Systèmes' 20,000 employees are bringing value to more than 270,000 customers of all sizes, in all industries, in more than 140 countries. For more information, visit 3ds.com.

