GETTING THE SIGNAL WITH DIGITAL TWIN

LEONARDO DEPLOYS DIGITAL TWIN TO CAPTURE IN-FLIGHT BEHAVIOR OF HELICOPTER RADAR

About the Customer

Leonardo, a global high-technology company headquartered in Italy, is among the world's top players in aerospace, defense, and security. Leonardo has a significant industrial presence in Italy, the U.K., Poland, and the U.S., and operates through subsidiaries, joint ventures, and partnerships, including Leonardo DRS, ATR, MBDA, Telespazio, Thales Alenia Space, and Avio. Leonardo leverages its technological and product leadership positions to compete in the international markets for helicopters, aircraft, aerostructures, electronics, cyber and security solutions, and space. Listed on the Milan Stock Exchange (LDO), in 2021 Leonardo recorded consolidated revenues of €14.1 billion and invested €1.8 billion in research and development.

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> By using an accurate, accessible digital twin, we can easily optimize the multiphysics performance and evaluate design sensitivities while also reducing physical prototyping.
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> Romano Iazurlo, Chief Technology & Innovation Officer, Electronics Division, Leonardo S.p.A.

Learn More at:
altair.com/digital-twin

FEKO_DigitalTwin

9500 → freq_MHz	gain_dB ►
90 → phi_deg	gain_max_dB ► 32.3436
∿∿∿ → theta_deg	theta_deg_G_max ► 0
	SLL_dB ► 25.8398
	HPBW_deg ► 2.02501
	FNBW_deg ► 3.6

Their Challenge

Leonardo's electronics division was assessing antenna-transmission loss of a helicopter radar system that was caused by in-flight vibration to the helicopter's radome. As vibration deformed the radome and antenna within, the antenna's electromagnetic behavior changed. Leonardo needed to capture the changes at the antenna-system level. However, physically measuring deformation and tracking electromagnetic behavior during flight was impossible. Leonardo needed a solution to predict the behavior and optimize the design of the antenna to meet mission requirements.

Our Solution

Altair and Leonardo used a multiphysics approach to build a structural and electromagnetic digital twin of the antenna system and optimize the radome design.

Leonardo supplied geometric information and boundary conditions for the antenna. With this, Altair created an Altair® OptiStruct® model and predicted deformation resulting from vibration impacting the antenna. Leonardo validated the model using bench-test data where antenna vibration was captured via sensor and measured.

Next, the team used Altair® Feko® to feed the deformed shape data into a model, evaluate antenna behavior, and determine the effect of antenna-plate deformation on the radiation pattern. Leveraging Altair® romAI™ with Altair Activate® , they generated a reduced-order model (ROM) to decrease simulation time while maintaining the accuracy of high-fidelity simulations. Activate also calculated key performance indicators of the antenna's radiation pattern based on Feko results obtained with the nominal shape of the antenna plate. For the radome, the team predicted material properties with Altair® Multiscale Designer® to minimize weight and intrusion impact – resulting from a bird strike for example – and used Altair® Radioss® to solve the highly nonlinear problems involving dynamic loadings of in-flight conditions.

Results

Altair correlated deformation to the antenna's design, tracked changes based on vibration, and calculated the antenna's electromagnetic signature. With this, Leonardo could optimize the next physical build version of the antenna without using expensive physical prototypes.

Altair's solution also closed loops between Leonardo's structural and electronics engineering departments by enabling teams to evaluate the radome and antenna system in a unified ecosystem. Collaboration around the digital twin mitigated information silos and slashed turnaround times. The streamlined workflow produced valuable insights into the antenna radiation patterns, physics drivers, and best trade-offs among technical requirements early in the development cycle, saving the team time and technical resources.
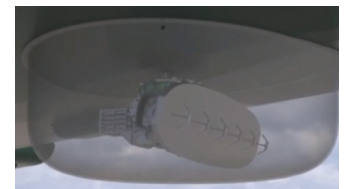
TOP: Helicopter with simulation results of radome and electromagnetic pattern
RIGHT: Rendering of radome and antenna
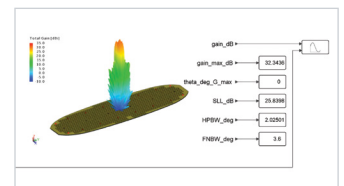
Leveraging Feko and Altair Activate to analyze the antenna's electromagnetic behavior
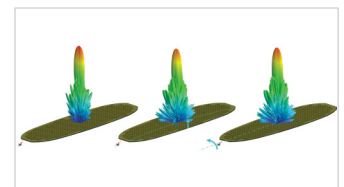
Comparing the original shape (left) of the electromagnetic pattern with variants