



Big Data in the Hangar: Virtual Damage Assessment & Repair Tracking for F-35 and F-22 Aircraft

EXECUTIVE SUMMARY

The F-35 Lightning II is a family of fifth-generation stealth aircraft developed by Lockheed Martin. The single-engine stealth fighter is designed for the nine participating nations in the Joint Strike Fighter (JSF) program — the largest cooperative initiative of its kind since World War II — with the United States as the primary customer.

Along with the aircraft itself, Lockheed Martin delivers F-35 sustainment support, which includes training, prognostics and maintenance. The goal of the application is to help military customers improve on-the-job support, while prolonging equipment life and maximizing the aircraft's operational availability. Key objectives are to streamline capture and communication of damage data, reduce sustainment costs, and enhance pilot safety through optimal maintenance.

THE CHALLENGE

As part of effective maintenance for any aircraft, accurately assessing airframe damage resulting from combat or environmental hazards is crucial. Seemingly small factors — such as the depth of a scratch or the distance of a hole from supporting structures — can impact flight-worthiness, aircraft stealth capability and pilot safety. As well, in an era of reduced spending and personnel, aircraft maintenance technician efficiency is essential.

Recognizing these challenges, Lockheed Martin sought to streamline its damage and assessment process for the F-35.

Traditionally, maintenance technicians would manually assess and track damaged areas by placing a transparent film over these areas and tracing reference points (such as fasteners and seams) with a marker. They would then cross-reference this information with repair data history captured in a spreadsheet. However, cross-referencing line drawings did not provide the optimal platform to visualize repair information, it was also quite cumbersome and time consuming — leaving more room for maintenance errors.

THE SOLUTION

To help its military customers drive maintenance technician efficiencies and improve maintenance accuracy, Lockheed Martin engineers adopted interactive 3D technology to integrate into their existing information infrastructure for the F-35 — called the Autonomic Logistics Information Systems (ALIS) software suite — streamlining a broad range of capabilities including operations, maintenance, prognostics, supply chain, and customer support services data. Their requirements were rigorous. The solution needed to: provide accuracy within 1/10th of an inch; allow complex 3D datasets to run interactively on tablet computers; and be user friendly for flight line maintainers.



To satisfy these demanding requirements, Lockheed Martin selected NGRAIN to transform its damage assessment and repair system. Working closely with Lockheed engineers, NGRAIN developed the industry's first interactive 3D Virtual Damage Repair and Tracking™ solution. Based on NGRAIN's volume graphics technology (which provides optimal rendering performance on laptops and supports the high degree of accuracy required), and developed using NGRAIN's Software Development Kit (SDK), the solution allows aircraft maintainers to capture damage information within a detailed 3D virtual model of the aircraft.

When working with the damage assessment solution, the technician specifies the aircraft tail number — the aircraft's unique identifier. The solution recognizes this number and immediately displays historical damage and repair data for that particular aircraft. The technician then enters metadata — such as damage type and dimensions — which is stored in the ALIS backend for future retrieval. Maintainers can use the solution to identify location of damage, insert photos and notes, as well as visually locate parts for ordering. The virtual damage assessment software — delivered on portable, ruggedized Panasonic Toughbook® computers — works with other software applications within ALIS to help maintainers quickly assess whether or not damages adversely impact aircraft mission capability. It also helps maintainers determine which damages need to be repaired to restore the aircraft to mission capability. The solution was first delivered with F-35 aircraft to United States Air Force (USAF) test sites, and is now being deployed to aircraft procured by other nations participating in the JSF program.

When working with the solution, USAF maintainers reported they could more easily visualize damage repair data thanks to this integrated technology and appreciated having immediate access to historical aircraft information post-operations. This has helped maintainers save time and reduce the maintenance time-to-flight hour ratio. After seeing the F-35 VDA solution in action, USAF officials requested the same solution for the F-22 Raptor. This twin-engine aircraft — intended primarily for air-to-air combat — shares similar wing and tail designs with the F-35.

Lockheed Martin again selected NGRAIN to configure its software for F-22 maintenance. As part of the project, NGRAIN modified the solution for F-22 part numbers and identifiers. In addition to helping maintainers track and record exterior aircraft damage, the F-22 NGRAIN solution allows technicians to view the interior of wing inlets. NGRAIN engineers also configured the solution for Lockheed's Integrated Maintenance Information System (IMIS), a software suite that is the information backbone for the F-22.

"The fact that NGRAIN is the only supplier outside of the US that has ever worked on the F-22 is a testament to the F-35 tracking and repair solution's effectiveness."

- Jeff A. Babione, Vice President of the F-22 Program

RESULTS

By leveraging NGRAIN solutions, Lockheed Martin has transformed the damage assessment and repair process for the F-22 and F-35 aircraft. Traditional methods, involving line drawings and cumbersome spreadsheets, have been replaced with streamlined processes integrated with back-end software systems. With these virtual damage assessment solutions, aircraft maintenance technicians can:

1. Increase Operational Availability of Equipment: When an aircraft lands, maintainers on the flight-line can connect to the database and immediately determine whether the aircraft is flight-worthy.
2. Work More Efficiently with Fewer Personnel: Using a streamlined process, maintainers can reduce the time required to document, assess and repair damage. In the case of the USAF, because the F-35 and F-22 solutions have similar workflow, aircraft maintainers can easily transition between the two platforms.
3. Capture Data More Accurately: Providing maintainers with the ability to visualize and accurately represent aircraft damage on a 3D model reduces the probability of maintainers making mistakes, which translates into safety for pilots.
4. Ultimately, the solution enables Lockheed Martin to help military organizations ensure equipment is mission-ready by providing new ways to efficiently and accurately maintain aircraft.

ABOUT NGRAIN

NGRAIN allows the world to see beyond reality. Their patented virtual and augmented reality applications are in-use around the world by leading organizations in aerospace, defense, energy, healthcare, and heavy industry; transforming the way they visualize, share, and understand the world around them. Through industry-first development platforms, authoring tools, and industrial applications, NGRAIN enables organizations to accelerate decisions by interacting with the world's data in 3D.

ABOUT THE INDUSTRIAL INTERNET CONSORTIUM

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