

Customer Application

Stratolaunch Talon-A

Hypersonic Testing Platform



Stratolaunch Achieves High-speed Milestone Using Hardware-in-the-Loop (HiL) Simulation with Concurrent Real-Time's RedHawk Linux OS and SIMulation Workbench

RedHawk Linux's guaranteed hard real-time performance is used in Stratolaunch's mission-critical hypersonic testing application.



Introduction

Stratolaunch is a private aerospace company that was established with the goal of revolutionizing space launch capabilities. The company is headquartered in Mojave, California, and is known for its innovative approach to airborne payload launches. Stratolaunch strives to create a more flexible and cost-effective means of enabling increased access to the hypersonic flight environment. The air-launch platform Roc, which is one of the largest airplanes in the world by wingspan, is designed to serve as a mobile launch platform for hypersonic testbeds called Talon-A, intended to fly a variety of experiments at hypersonic speed. This airborne launch approach allows for greater versatility in choosing launch locations and angles, reducing the constraints of traditional ground-based launches. By launching from high altitudes, the carrier aircraft minimizes the fuel needed to reach higher altitudes with ideal atmospheric conditions to reach higher speeds.

"It is validating to have something that we've spent so many years working on come together, and see it do exactly what we have seen it do in the HiL. Because we were able to see data that matched our predictions, we were confident that our models were quality code and that our process works to verify our understanding of what the Talon-A does, and how it responds."

Brian Pincock
Staff Systems Engineer Stratolaunch

Challenge

When it comes to dropping an airplane from another aircraft, the expectation is that it should begin flying immediately. Unlike manned or unmanned aircraft that take off from the ground, which undergo gradual speed buildup and envelope expansion, the process for the Talon-A platform at Stratolaunch is quite different.

As the Talon-A is released from another aircraft, it's already moving at high speeds, requiring instant flight capabilities. This demands immediate functionality from its propulsion system, leaving no room for gradual acceleration or testing phases.

Stratolaunch's hardware-in-the-loop (HiL) lab plays a crucial role in ensuring the success of the Talon-A platform. By replicating as much of the hardware on the ground as possible, engineers can thoroughly test and validate the system's performance before it takes to the skies.

This meticulous testing process is essential for gaining confidence in the seamless integration of various components, especially given the high-speed nature of the Talon-A's deployment.

Ultimately, the HiL lab serves as a vital testing ground for the Talon-A platform, allowing engineers to verify that all systems function harmoniously from the moment of release.

With the propulsion system needing to work flawlessly and immediately upon deployment, the rigorous testing conducted in the HiL lab is instrumental in ensuring the success and safety of each mission.

The HiL lab serves as Stratolaunch's virtual testing and prototyping ground where software is evaluated on the actual vehicle hardware, often involving collaboration across multiple teams. In Mojave, the Stratolaunch team develops the onboard code, which is then integrated into the vehicle management computer alongside Draper's guidance navigation and control solution. With numerous virtual separation flights conducted in the HiL lab, recent tests on Talon-A0 (TA-0) have bolstered confidence in the functionality of Talon-A1 (TA-1).

Solution

Stratolaunch leveraged the SIMulation Workbench (SimWB) framework, specifically designed for the RedHawk Linux real-time operating system and deterministic simulation use cases.

This combination facilitated the execution of advanced Monte Carlo simulations, customized models, and SimWB scripting capabilities to automate the testing process across a wide array of models.

These models were meticulously crafted with varying parameters and initial conditions, ensuring comprehensive coverage of potential scenarios.

SimWB plays a vital role within HiL simulation testing and is crucial for replicating real-world conditions for the Talon-A. By simulating various environments and scenarios, HiL testing offered valuable insights and predictions of the system behavior.



Engineers use SIMulation Workbench to virtually test and engineer flight of the Talon-A in the HiL lab.

Recognizing the importance of automated testing in this complex environment, Stratolaunch also leveraged SimWB's intuitive Python API to streamline processes and minimize errors.

More over, SimWB facilitated regression testing to validate and verify design decisions and ensure resilience against potential issues from future hardware modifications or updates.



Benefits

✓ Improved Confidence:

HiL simulations conducted in the lab allowed Stratolaunch to test the Talon-A platform's software on actual hardware, instilling confidence in the system's performance and functionality.

✓ Enhanced Efficiency:

Utilizing SIMulation Workbench (SimWB) framework streamlined the testing process by automating various scenarios and parameters, resulting in overall efficiency and productivity for the testing team.

✓ Greater Accuracy:

The use of Monte Carlo simulations and the SimWB Python API ensured testing of different models and conditions, allowing the HiL efforts to assess accuracy and observe the margin for error.

✓ Comprehensive Regression Testing:

With SimWB's capabilities, Stratolaunch performed thorough regression testing; identified and addressed potential issues, and updated the hardware without compromising existing functionalities; and maximized the integrity of the Talon-A platform.

Summary

Stratolaunch acknowledges the successful implementation of hardware-in-the-loop simulations, leveraging the Concurrent Real-Time SIMulation Workbench framework, which significantly enhanced testing efficiencies, accuracy and confidence in the performance of their hypersonic Talon-A platform.



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