Enhancing Reliability Engineering through Advanced Visualizations and User Interfaces

*Reliant Slide Format
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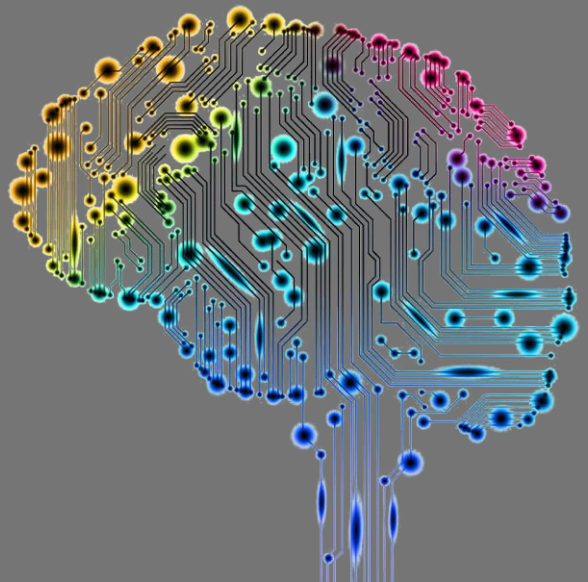
Agenda



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Introduction

Welcome Attendees,

Today, we will set the stage for the integration of Artificial Intelligence and Machine Learning into Advanced User Interfaces.

I want to introduce you to some Key capabilities of Advanced User Interfaces and how we can utilize Machine Learning and AI applications in immersive visualizations for enhanced situational awareness and performance monitoring.

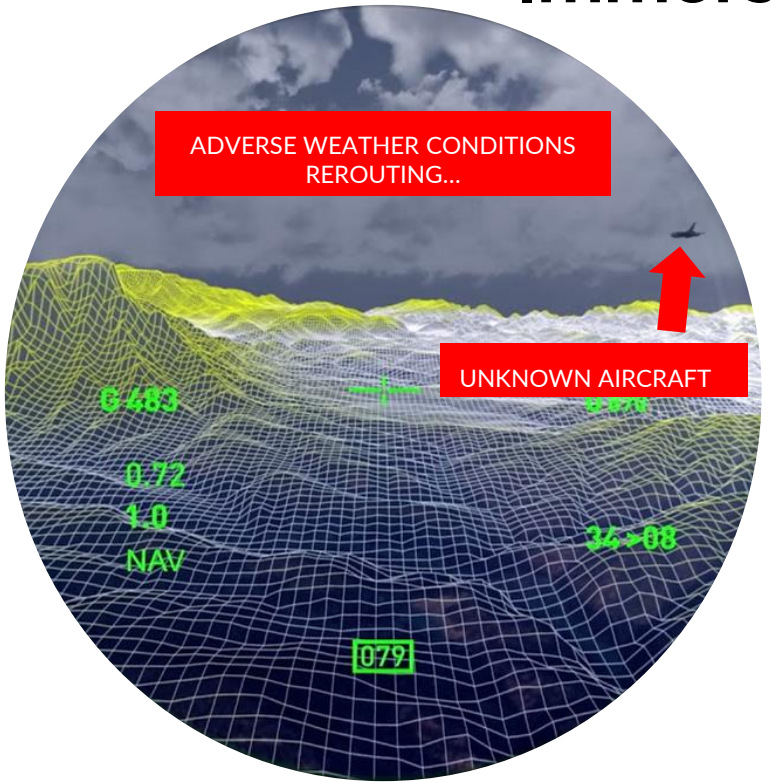
Reliant Technologies - LogSIL

Who we Are
At Reliant Technologies' LogLAB, our mission extends beyond the development of advanced AI systems for aviation. We're deeply committed to supporting the U.S. Army's Logistics Engineering Laboratory (LogLab) in their analysis of critical programs like FLRAA , FARA , ITE, UAS, MRC , and AIAMD.

From LogSIM to LogSIL
Our journey began with LogSIM, focusing on simulation-based analysis using the System of Systems Analysis Tool (SoSAT) to provide vital life cycle metrics like costs and operational availability for Army aviation. As we transition to LogSIL, our mission expands to emulating Future Vertical Lift systems, focusing on aircraft health monitoring and prognostics data for FLRAA, FARA, and Future UAS.

Our Goal
The driving force behind our LogSIL work is to assess, analyze, and optimize advanced technology. We are committed to ensuring that these cutting-edge systems align seamlessly with military operations, enhance readiness, and contribute to the safety and effectiveness of our armed forces.

Immersive 3D Visualizations



Enhanced Situational Awareness
Immersive 3D models of the aircraft and its surroundings provide pilots with an unparalleled level of situational awareness to better understand their spatial orientation and the overall flight environment.

Surroundings Visualization
Pilots can view terrain, air traffic, weather conditions, and other relevant information in a 3D context empowering them with valuable situational insights.

Benefits for Pilots

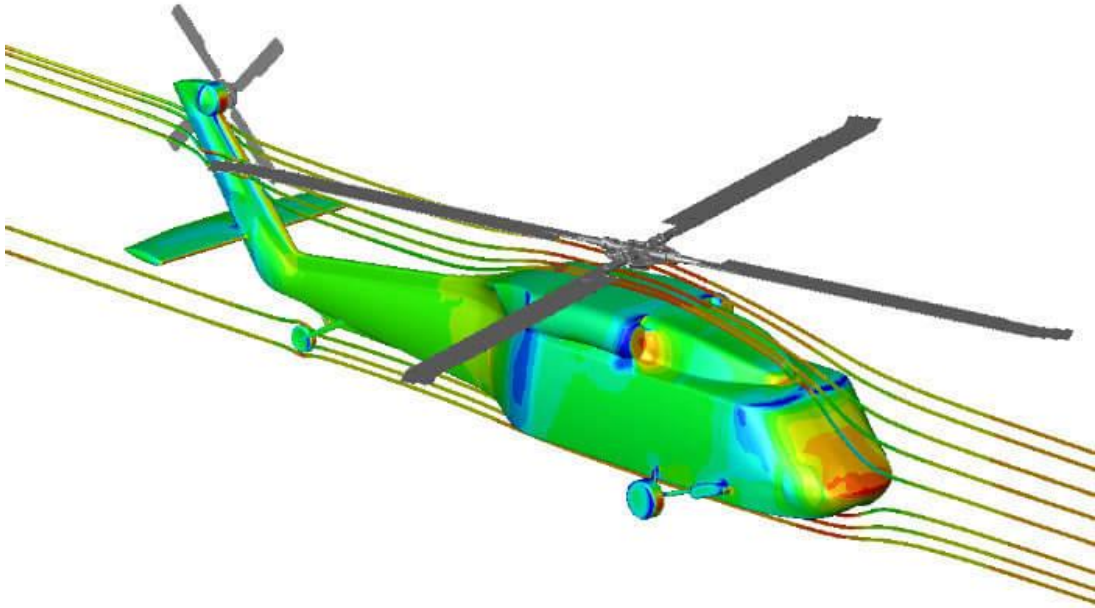
- Improved spatial perception.
- Faster response to changing conditions.
- Enhanced decision-making capabilities.

Real-Time Performance Monitoring

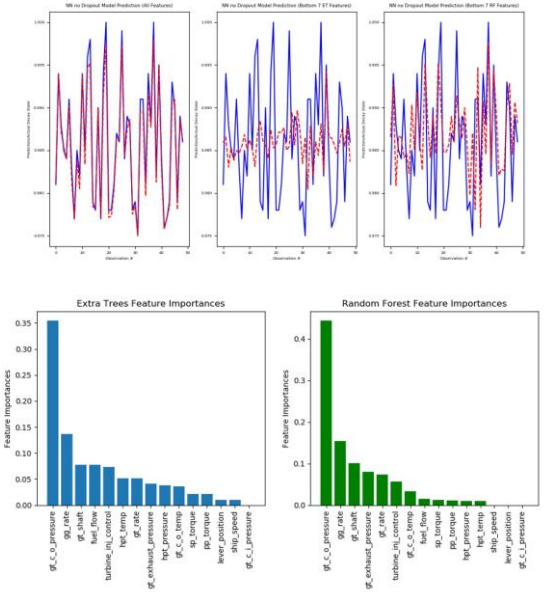
Real-time monitoring offers the advantage of timely issue detection, allowing for rapid responses to ensure aircraft safety and mission success. Additionally, it enables pilots to maximize operational efficiency by making immediate adjustments based on real-time performance metrics.

Key Metrics

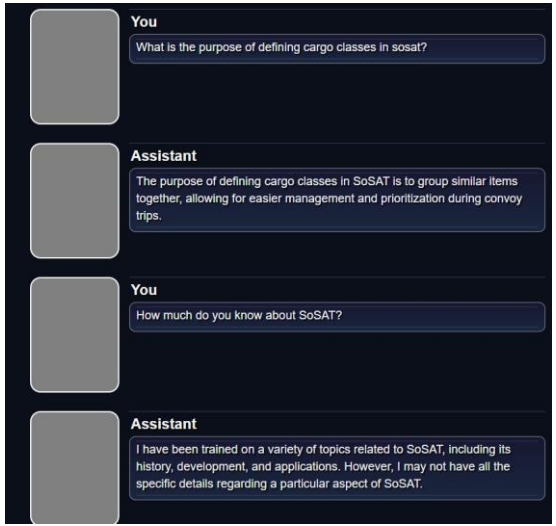
- Engine Health
- Structural Analysis
- Environment Conditions
- Navigation
- Fuel, Airspeed, and Altitude
- System Diagnostics
- Safety Alerts



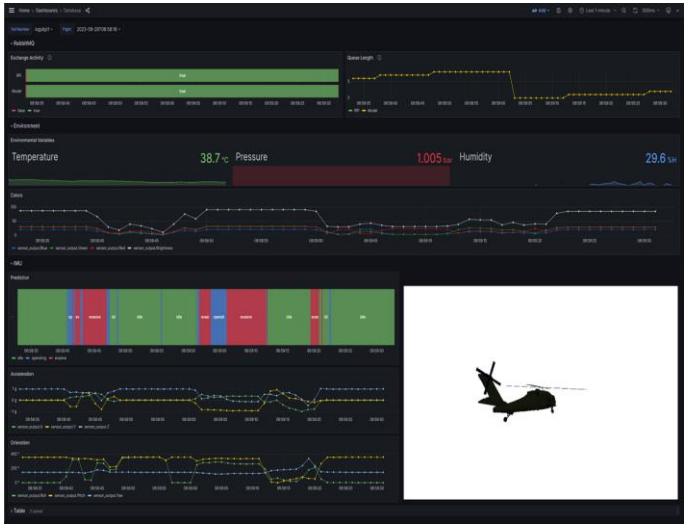
Reliant's Advancements in Immersive Visualizations



Running sensor data through these ML algorithms has enabled us to detect patterns, anomalies, and critical insights in real-time, further enhancing our ability to provide timely and accurate information to users.



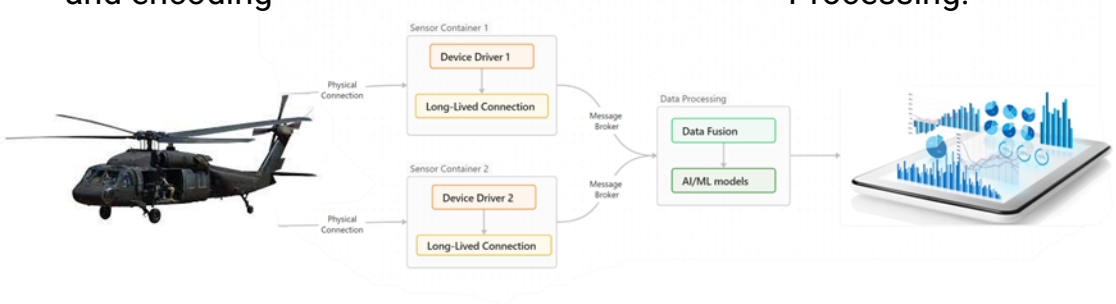
Furthermore, we're pioneering Natural Language Processing and Artificial Intelligence applications to enhance system interactions and functionality.



Our team has actively explored and applied 3D modeling and visualization software like Unity, ThreeJS, and Grafana to create immersive environments.

Data Pipeline

Data Collection	Pre-processing	Validation	AI/ML	Visualizations
Gather raw data from on-board and mounted sensors.	Clean, organize, and refine the data. This involves removing errors, normalizing values, signal smoothing and encoding	Verify accuracy and consistency of Processed Data.	Feed data into our AI/ML Pipeline that will utilize Computer Vision, Data Fusion, and Natural Language Processing.	Produce Visualizations, Recommendations, and Performance metrics to the user all at the Edge for Enhanced Decision making.



Machine Learning Integration

Machine Learning continuously analyzes aircraft data, identifies patterns, and issues alerts when anomalies or potential failures are detected. This proactive approach enhances safety and reduces maintenance downtime.

ML algorithms empower Data Analysis and Actionable Intelligence:

- Reliants ML algorithms excel in data analysis, boasting the capability to efficiently summarize sensor data, integrate information from diverse sources, and effectively apply prognostics and predictive maintenance algorithms.
- These algorithms perform data analysis swiftly, enabling the rapid identification of trends, anomalies, and potential issues.
- Furthermore, ML algorithms can provide real-time actionable intelligence, encompassing maintenance recommendations, part replacement schedules, and mission-specific insights.

Benefits and Future of ML Integration

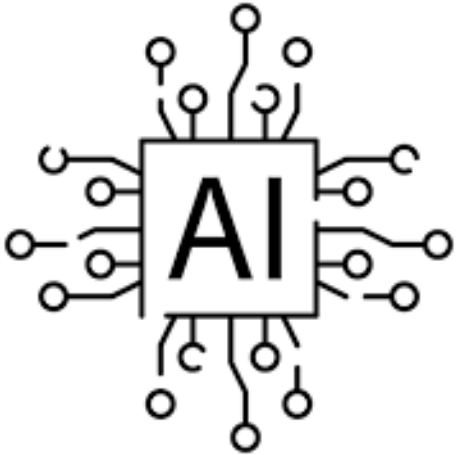
Benefits:

- Enhanced safety through early threat detection.
- Improved situational awareness for pilots.
- Efficient data analysis and decision support.
- Real-time actionable insights.

Future Work:

- Voice assistance for seamless system-operator communication
- Computer Vision Models powering :
  - Missile detection
  - Intruder/face detection
  - Weather prediction

AI-Integrated User Interface



Voice Recognition and AI

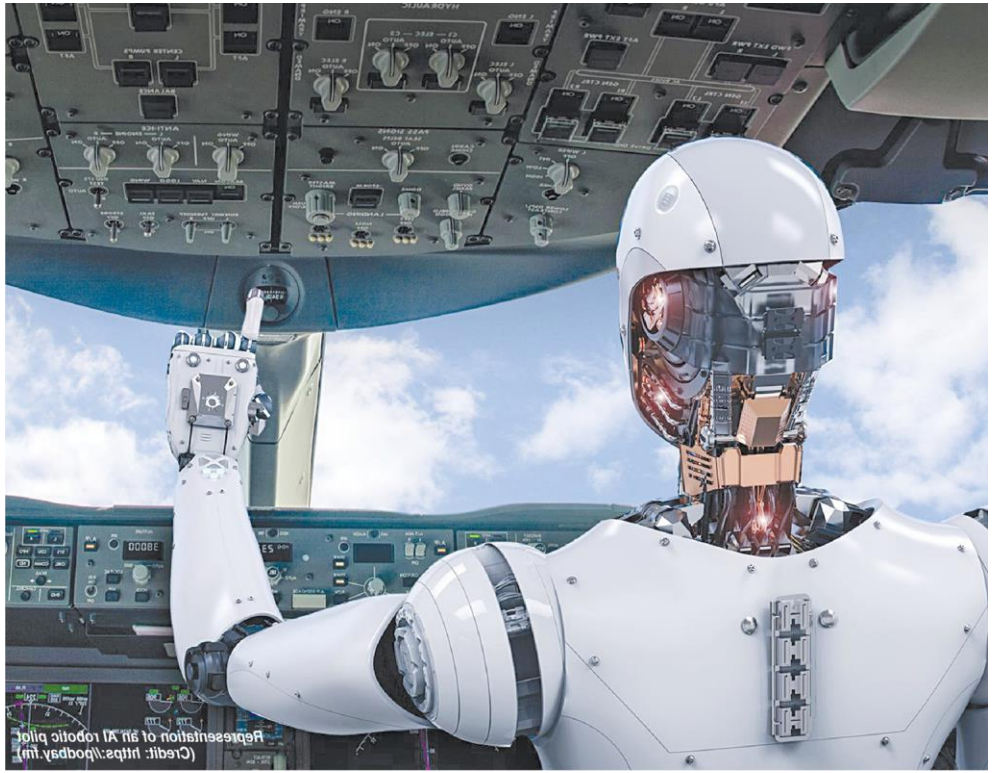
- Enabling voice recognition, akin to Siri and Alexa, for effortless communication with the AI assistant.
- Leveraging advanced AI to process voice commands and provide voice-based responses.
- Creating a virtual AI assistant proficient in understanding mission objectives, interpreting sensor data, and interfacing with in-flight systems.
- Delivering flight suggestions, real-time intelligence, and support through natural language responses and visualizations.

Data Analysis and Actionable Insights

- Utilization of Machine Learning, Natural Language Processing, Image Processing, and Human-Computer Interaction technologies.
- Ability to summarize sensor data, perform quick analysis, and provide actionable intelligence to users.

Benefits of AI integration:

- Hands-free operation
- Reduced pilot workload
- Improved response time
- Enhanced situational awareness
- Efficient data analysis
- Real-time support for complex tasks



Human Factors in AI System Adoption

Human factors are vital because they directly impact the acceptance and integration of AI systems. Understanding user-friendliness, usability, and user perceptions ensures practical, user-centric AI implementations.

Through university partnership with UAH we have come to the conclusion that human factors is important in the adoption of these new AI systems

To achieve proper adoption the system must be a user-friendly, highly interactive design that prioritizes:

- Simplicity.
- Functionality.
- Usability.

A simple Human factors study can shape future AI system development by aligning designs with user needs. Additionally, it informs more effective training programs, ensuring user-friendly and well-adopted AI systems.

Conclusion

In Conclusion, Our dedication to research and development has yielded remarkable advancements in 3D modeling, Machine Learning, and Artificial Intelligence.

Reliant is committed to providing immersive, user-friendly interfaces that empower military personnel with invaluable insights. Our work extends from enhancing aircraft health monitoring to revolutionizing data analysis, making systems more proactive and intelligent.

As we transition from LogSIM to LogSIL, our journey underscores our determination to test and analyze advanced technologies, ensuring traceability and excellence throughout the Future Vertical Lift Life Cycle.

Thank You

Thank to the Society of Reliability Engineers for the opportunity to present.

Q&A

References