Avitas Systems
a GE venture

Autonomous aerial inspection system for vertical assets

Technology introduction
and use in Avitas Systems
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INTRODUCTION

Avitas Systems partners with market leaders in technology, integrating autonomous robots and advanced sensors into its automated, end-to-end inspection systems, making the process of inspection safer, repeatable, and more efficient.

Avitas Systems developed a generalized autonomous aerial inspection system, specifically to inspect vertical assets, such as flare stacks, transmission towers, and tanks. The system integrates rotary-wing aerial robotics, software applications, and sensor technology such as RGB, IR, LiDAR, UV, and multispectral cameras. This integrated system uniquely enables safe and disciplined autonomous flight operations in relation to 3D models, ultimately leading to precise and 3D targeted inspections.

The autonomy developed in vertical asset inspection is transferable across aircrafts, sensor types, and industries, such as power and oil and gas.

BENEFITS OF AUTONOMOUS AERIAL INSPECTION SYSTEM FOR VERTICAL ASSETS

Inspectors often access vertical assets using ladders, scaffoldings, cherry pickers, ropes and harnesses, or a helicopter. These methods can be unsafe for the inspector, costly, and often require the asset be taken out of service. Most customers have to wait weeks to see inspection data and findings, and during that time, asset conditions may decline. Additionally, the collected data and final reports are localized, and the subjectivity of inspectors' experience is not repeatable, which can affect the accuracy of manual inspection methods.

Unmanned aerial vehicles (UAVs) for vertical asset inspections solves the accessibility problem, but UAV inspections are not always repeatable. UAVs are usually manually operated by pilots, and asset safety and data quality are often at risk, since UAVs collect data from far distances, or they don't accurately target points of inspection to cover the entire asset. These methods treat all parts of vertical assets equally, even though in reality, some areas need more thorough inspection than others.

By automating the end-to-end inspection process, the Avitas Systems aerial inspection system for vertical assets significantly improves speed of execution, safety, precision, and efficiency concerns associated with current methods of inspection.

Speed of execution

Because the Avitas Systems inspection system is automated, no time is wasted in waiting for manual intervention, or for data to move from one team to the next. Additionally, inspectors don't have to comb through massive amounts of results, since anomaly detection is automated.

This system provides an intuitive, software-based interface for inspection planning and data collection through 3D modeling. Inspectors can select points of nterest (POI) on digital 3D models of a vertical asset by selecting a POI on the model, change the perspective of the model to define the sensor angle, and indicate the size of the resolvable defect (e.g., crack of 1mm, corrosion patch of 2sq inches, etc.) by extending the POI, which translates into the UAV's standoff distance. This point and click method reduces the inspection planning time from hours to five or ten minutes. The system autonomously converts this inspection plan, integrated with existing requirements, into flight paths for data collection.
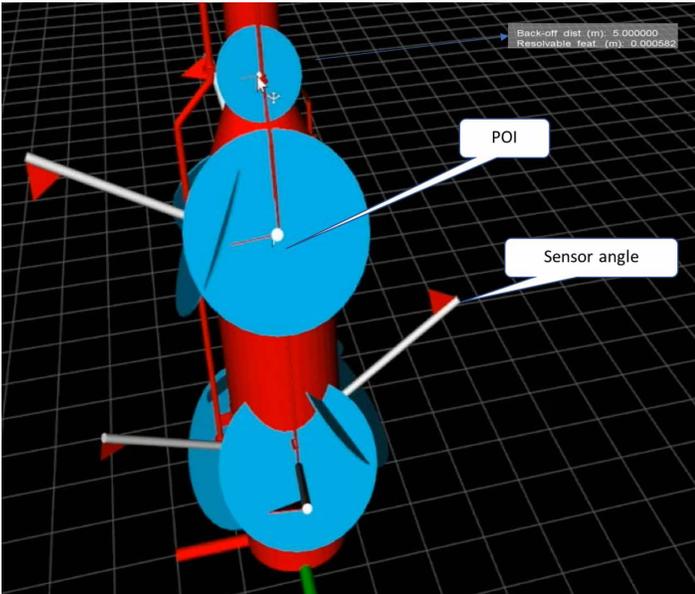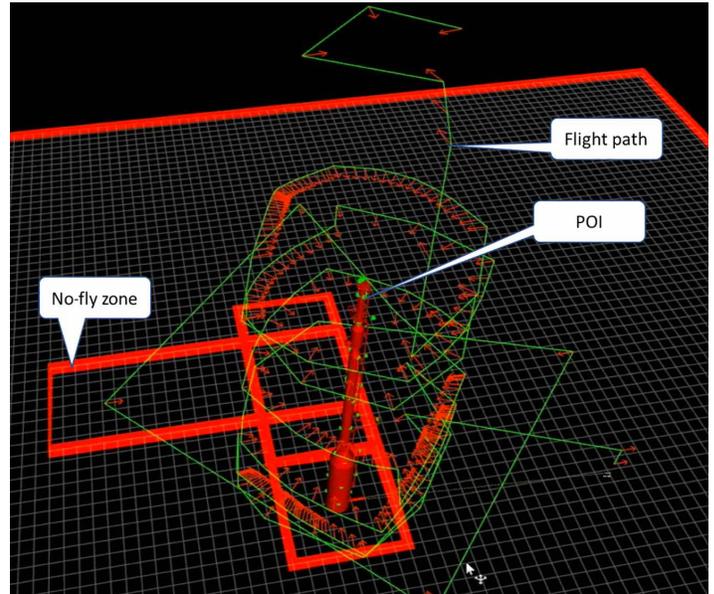
Users can change the 3D model perspective to define the sensor angle and determine UAV standoff distance by extending the points of inspection (POI).

Inspectors can define no-fly zones of any shape and size on the 3D models, which convert to UAV flight paths.

Safety

Human and asset safety is a large concern across industries. Before flying, the system software autonomously performs an airworthiness diagnosis and will not fly the mission if the requirements are not met. The system also has multiple built-in safety features, including contingency management modules to monitor performance of critical components such as battery life, communication, RTK and GPS signal strength, and course correction. If these modules' performance drops below the configured threshold, then UAV pilots are alerted, and the modeling system takes corrective action.

The 3D model allows UAVs to navigate around obstacles, so there is no crash risk. Customers can define no-fly zones of any shape and size. Measurements of no-fly zones are three dimensional, meaning the length width, and height can be adjusted. For example, if the height of the no-fly zone is ten meters, and the minimum safety standoff distance is seven meters, then the UAV will stay 17 meters above the no-fly zone.

Avitas Systems equips the UAVs with a triple redundant IMU and GPS receivers to maintain precise flight control in case of failure, which ensures mission robustness.

Additionally, Avitas Systems separates safety-critical communication from mission-critical communication. Independent communication systems ensure that in case of unforeseeable circumstances, the operator on the ground can take control.

Although this system is entirely autonomous, Avitas Systems provides continuous situational awareness throughout the mission, including forward simulation, which compares system-intended action with original planning so the operator can take corrective action, if there's a discrepancy. Avitas Systems also has live feed capabilities so operators can receive updates from the UAV's cameras in real time.
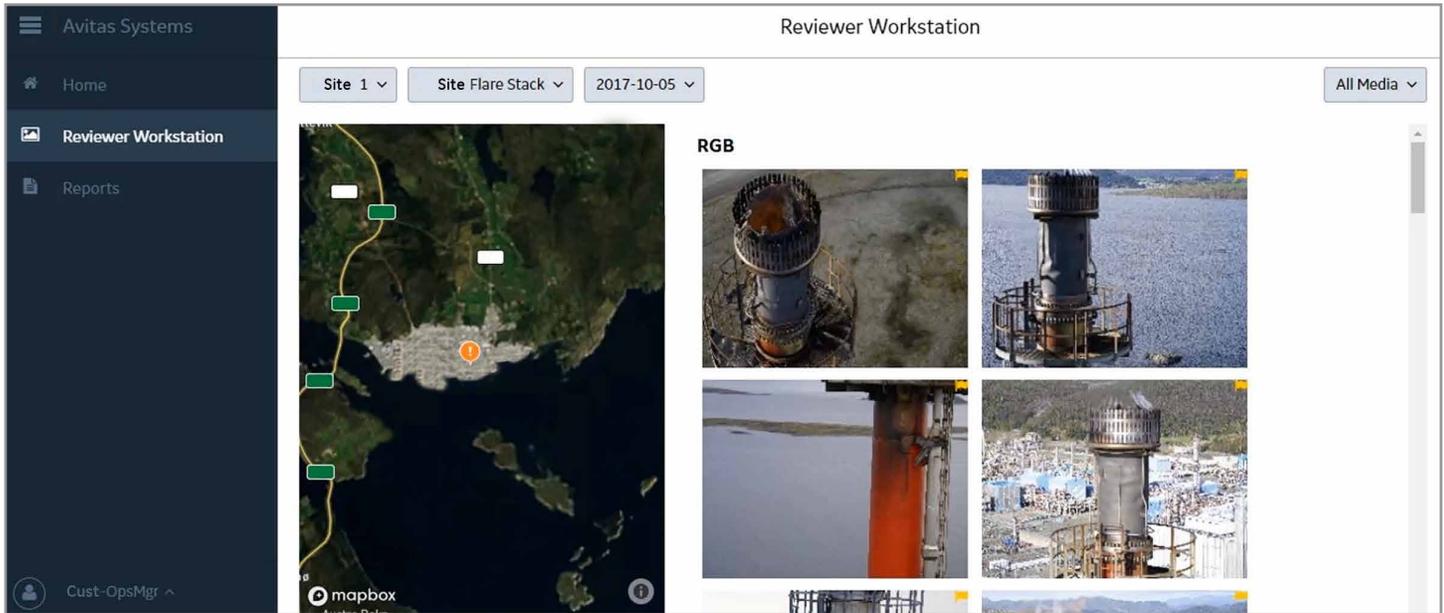
The Reviewer Workstation provides contextual visualization of inspection data by location.

Consistency, precision, and efficiency

Since this system is fully autonomous, Avitas Systems can target POI from the same distance and angles at a site, even if the inspections are years apart. Consistent and repeatable inspection execution enables change detection over time, and automated defect recognition takes the human subjectivity out of data analysis to ensure accuracy in inspection reports.

The web-based interface, Reviewer Workstation, provides contextual visualization of the inspection data and anomalies to ensure inspectors accurately trace defects back to their physical location on the asset, calculating the precise location on the 3D model. Correctly identifying the location of anomalies means speedy and cost-effective repair.

Since the system inspects vertical assets while they are in operation, no revenue is lost due to downtime. Avitas Systems can inspect multiple vertical assets per day, compared to a single asset over the course of multiple days, which scales operations at a significantly increased speed.

AVITAS SYSTEMS, A GE VENTURE

Through fully automated inspection management, smart scheduling, safety compliance, asset defect recognition, and predictive analytics, Avitas Systems has provided system solutions across a wide variety of assets and industries. These solutions overall reduce downtime and risk while optimizing resources. Visit us at avitas-systems.com or on Twitter @Avitas_Systems.