Maintenance | Aerospace and defense | Defect detection / product inspection | Classifiers

Autonomous Drone Assisted Aircraft Inspections

BUSINESS PROBLEM

The safety of the passengers, crew, and maintainers is the number one priority for any aircraft manufacturer or operator. Visual inspections of the exterior of aircraft is critical to the safe operation of aircraft, as defects such as corrosion, lightning strikes, or missing parts can compromise the structural integrity of the whole aircraft. Currently, aircraft visual inspections are conducted by human maintainers in a process that is not only time consuming, but also puts the maintainer and the aircraft at risk, as maintainers have to use lifts and cranes to inspect top portions of the aircraft, while walking along the wings and spine.

APPROACH

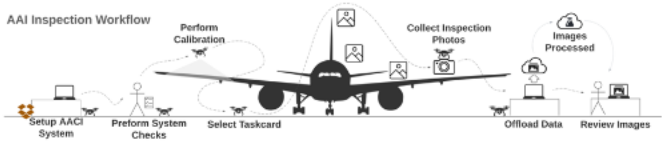
Maintainers use a laser based navigation autonomy enabled drone to capture aircraft inspection imagery. Captured images are then processed by a machine learning model, in order to identify defects on the external surface of the aircraft, aiding the maintainer in completing inspections in a more expeditious, thorough, and safer manner.

DATA SOURCES

Data available has been captured from proof of concept flight tests at Boeing facilities and various airlines. This data is in the form of the images captured by the drones during inspections, as well as metrics comparing the time to complete an inspection using drones compared to human-only inspections, and the accuracy of the drone assisted inspections compared to human-only inspections.

Data Types and Format

Data Types: Inspection imagery (database), performance metrics of time and accuracy of inspections (spreadsheets), output and performance of computer vision classification model (database).



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IMPACT

The implementation of assisted autonomous drone aircraft inspections decreases the risks to inspection personnel and aircraft, decreases the time required to conduct inspections, and improves inspection record management practices through the data collection process. Additionally, the data collected during this inspection process can be used to improve inspection and repair practices as well as potential design of future aircraft platforms.

DRIVERS

In recent years, there has been an increase in research and implementation of drone systems to conduct inspections across multiple industries that have traditionally been considered time consuming and risky to inspection personnel. More recently, startups have begun working with commercial airlines to test the potential of implementing drone technology for the conduct of aircraft inspections.

BARRIERS

There were two major barriers that impacted the outcome of the project. The first barrier was aircraft availability and coordinating with aircraft operators to test AAI processes on aircraft that are likely to have sustained defects. Another significant barrier was data and imagery of defects available to train machine learning models due to current inspection methods not dictating a standardized imagery collection procedure for defects.

ENABLERS

The Applied Innovation team has unique access to all of the Boeing business units, working with multiple different groups to help find support for and to implement projects. Along with the team's ability to work across business units, the Applied Innovation team has access to portfolio companies outside of Boeing, quickly able to iterate on new technology concepts.

ACTIONS

Actions taken to implement the solution include conducting market research to identify potential market share, customer interest, and competitor solutions within the field. Following market research, a process workflow was designed implementing the use of machine learning damage detection software into the inspection process and validated through experimentation with inspection personnel to determine the effects of machine bias.

INNOVATION

The assisted autonomous drone aircraft inspection process proposes a new innovative solution to conducting aircraft inspections utilizing an autonomous drone to gather imagery of the exterior of an aircraft prior to processing the imagery through a machine learning model to identify damages and defects before the imagery is reviewed by an inspector through a user interface.

IMPROVEMENT

The final solution provides an inspection methodology capable of increasing inspection quality and accuracy while decreasing the time required to conduct inspections. Through a focused study on machine bias, the proposed solution reduces the potential of human factors negatively influencing inspection results.

BEST PRACTICES

Someone attempting to replicate this solution should take a step based approach to implementation, focusing on the data collection phases of ensuring appropriate quality and accuracy of data capture by the autonomous system prior to incorporating machine learning algorithms in the data processing phase. It is also important to dedicate the appropriate time to the development and execution of training programs for personnel.

OTHER APPLICATIONS

Drone assisted aircraft inspections can be utilized in multiple industries from construction, transportation, energy, and agriculture. The methodologies discussed for assisted autonomous aircraft inspections using drone platforms can also be applied to other industries using rover platforms suitable for those environment such as autonomous underwater drones for subsurface inspections.