Avinocular: An Autonomous Mobile Robot for Aircraft Inspection

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Fatigue cracks are inevitable yet microscopic aircraft damages, often being the main factor leading to in-flight break-ups. Non-destructive testing (NDT) is generally used in detecting possible crack formation. However, in light of conventional NDT's inefficiency, coupled with the requirement for operational stabilization, it is currently heavily reliant on the inspectors' experience, which is often inadequate for identifying hidden fatigues. Our project set out to provide an alternative to conventional labor-intensive NDT with an autonomous mobile robot (AMR) that consists of four modules: chassis, scissor lift, telescoping mechanism, and robotic arm with a commonly-used NDT Ultrasonics device as the end effector. Inspection on the varying surfaces of the wings, fuselage, and empennage can be achieved through a control system comprising chassis route planning, which uses a trilateration-based localization algorithm, and robotic arm motion planning, which is based on capturing point clouds of the curved surface in real-time. An application is created for monitoring the whole inspection process and generating the goal positions for the chassis. Results of a series of experiments conducted on a real aircraft demonstrate, firstly, the feasibility of using the landing gears as the reference data to create a map for localization; secondly, the successful collaboration between obtained point cloud and robotic arm operation. Avinocular can serve as an assistant for inspectors to conduct consistently stable NDT on most aircraft components, thus effectively preventing the neglect of fatigue cracks and serious air crashes.

Awards Won:
Third Award of $1,000