SkyProbe: A Thrust Vectoring UAV for Enhanced Contact-Based Inspection Performance in Windy Conditions

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This project presents an innovative Thrust-Vectoring Unmanned Aerial Vehicle (UAV) specifically designed to perform contact-based inspections(ultrasonic crack detection, wave check, and adhesion testing) at high altitudes under challenging windy conditions. Traditional drones typically struggle with stability during close-proximity inspections due to rigid structures and limited responsiveness to turbulence. To address this, the developed UAV employs a unique thrust-vectoring system, utilizing servo-controlled propellers capable of dynamically adjusting their angles. This innovation allows the drone to maintain a stable, horizontal fuselage irrespective of external disturbances, significantly enhancing its inspection capabilities. A novel thrust-vectoring control logic was developed specifically for this UAV, integrating advanced control technologies such as feedforward PID control, an optical flow sensor, and laser altimetry. This control system provides precise real-time feedback and positional corrections, significantly improving drone responsiveness and reliability. This thrust-vectoring UAV not only surpasses traditional quadrotors in performance but also expands the potential applications for UAV technology in industrial inspection, promoting efficiency, safety, and accuracy in maintenance operations.

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