Woodpecker: A UAV-Based Sensor Deployment Monitoring System

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Traditional forest fire monitoring suffers from inherent flaws, including early warning lag, safety risks of manual sensor deployment in complex terrain, limited flight endurance of conventional UAV monitoring platforms, and high false alarm rates of single-dimensional sensing systems. This project presents the iteratively optimized Woodpecker system, an autonomous UAV platform implanting sensor-integrated darts into tree trunks to achieve long-term, distributed in-situ forest monitoring via a single flight mission. The initial prototype adopted a slider-crank mechanism and feedforward PID flight control, achieving a 76% dart penetration success rate, ±0.3? temperature measurement accuracy, and only 0.17° pitch deviation during launch, fully validating the feasibility of the core technical solution. Targeting the initial version's structural instability and high manual operation dependency, the system was iteratively refined with MPC flight control for enhanced disturbance rejection, a cam-spring energy storage catapult, optimized airframe structure, multi-type fire feature sensors, a coaxial HD image transmission system, and automated closed-loop launch control. Field tests verify the iterated system reaches over 85% dart penetration success rate, =0.1° maximum pitch deviation during launch with 0.3s stability recovery, 72+ hours of continuous data transmission, and wireless packet loss below 1%. This project provides a reliable technical solution for long-term forest environment monitoring and ultra-early wildfire warning.

Awards Won:

Fourth Award of $600