Undergraduate Team Design of an Affordable Open-Source 2-kg Payload Radiation Detection Drone

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Poster #M22

Introduction

- Autonomous drone for inexpensive background radiation surveys
- Outreach for high schools

Goals & Objectives

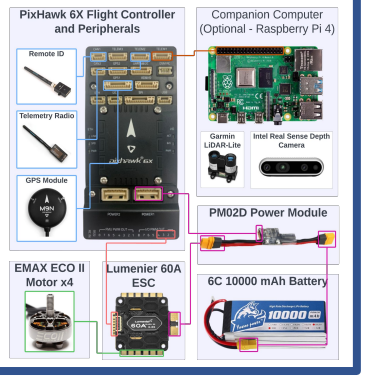
- Develop an accessible, affordable drone design for rapid source localization

Methods/Technical Approach

- Intelligent navigation and survey algorithms
- Collision avoidance and terrain following procedures enable autonomy
- Customized 3D-printed frame allowing various integrations
- Ionizing radiation emulation with WiFi for safe testing

Metric	iRAD Performance	COTS Drone Performance
Cost of Frame	$50	$140
Frame Mass	513 g	610 g
Max. Payload	2 kg	1.5 kg
Flight Time	10 min	15 min
Flight Range	5.75 km	7.5 km

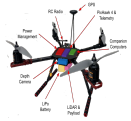
Avionics



Iterations


▲DJI F550 Drone

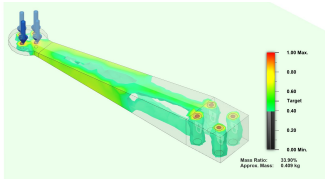

▲Modified DJI F550 Drone

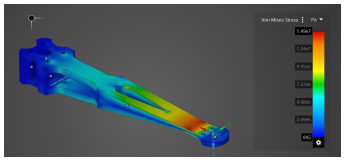

▲iRAD Quadcopter Drone


▲Aurelia X4 Commercial Drone

Frame


▲Designed using Fusion 360 CAD software, manufactured using Fused Filament Fabrication on Bambu X1-Carbon 3D printer


▲ Topology Optimization of Arm


▲ Finite Element Analysis of Arm

Testing


▲University of Michigan M-AIR flight facility


▲Plot of land to be surveyed by iRAD systems

Results/Major Findings

- Total cost: ~$1,750
- Rapidly producible, comparable to commercially available drones

Discussions/Next Steps

End product: Versatile radiation mapping drone with efficient navigation for reduced survey time

Future work: avionics testing, firmware configuration, flight time evaluation, remote ID module determination, selection of radiation detector, simulation and field testing

Conclusion/ Relevance(MTV)

Impact: Undergraduate research and support, presentations, publications

Tech Transfer: Open-source mapping drone design for outreach; navigation algorithm; share with commercial entities

Mission Relevance: Applications in monitoring and response, student opportunities, STEM and nuclear outreach

This work was funded in-part by the Consortium for Monitoring, Technology, and Verification under Department of Energy National Nuclear Security Administration award number DE-NA0003920

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