Rapid Repair of Intelligent Radiation Awareness Drone (iRAD) Using Additive Manufacturing

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Introduction and Motivation

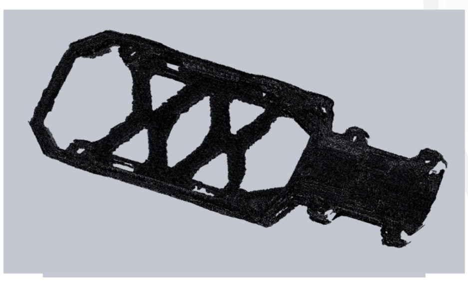
Accelerate repair of unmanned aerial systems (UAS)

- UAS have high risk of damage, replacing parts is expensive and slow
- Additive manufacturing can fix this by allowing less expensive and faster iteration and testing

Technical Approach

Identify, model, and reproduce non-durable parts

- Identified parts most susceptible to damage
- Created CAD models of motor mounts, frame plates, joints, and propellers using 3D scanner
- Improved parts to add structural integrity
- 3D printed using PLA and Carbon Fiber filaments, on Ultimaker S5 and Bambu Lab X-1 3D printers



Motor Mount CAD model

Results

Time to replace motor mount:

- Off-the-shelf: 14 d
- 3D printed: 6 h

Cost of motor mount:

- Off-the-shelf: $15.85
- 3D printed: $0.02 (0.13% cost)

Conclusion

Additive manufacturing allows faster and cheaper repair of UAS

- Lower cost of material and higher speed of production
- 3D printing is a versatile method of repairing and manufacturing UAS

Next Steps

Model and reproduce full UAS

- Verify parts with flight testing
- Perform Finite Element Analysis
- Develop and improve parts, until UAS can be fully 3D printed

Protecting iRAD-Lite: Damage-Reducing Approaches for a Customized Drone Designed for High School Outreach

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Introduction and Motivation

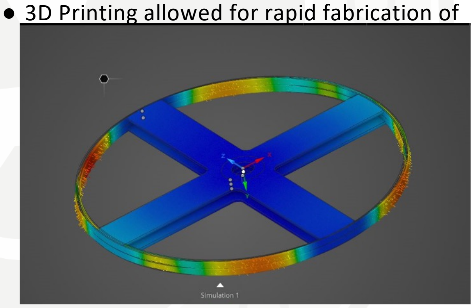
Design & Fabricate damage-reducing parts

- An affordable homemade drone with a radiation sensor payload
- Made for high school educational outreach
- High likelihood of frequent crashes
- Inexperienced pilots
- Lack of collision avoidance system

Technical Approach

Identify damage-prone parts

- Minimize damage to the drone
- Redesign of parts that are susceptible to damage
- Discover susceptible parts through various testing phases
- 3D Printing allowed for rapid fabrication of



Finite Element Analysis (FEA) of Propeller Guard

Results

Ansys Discovery Simulation

- Assuming 100% density
- Max Displacement: 2.67 mm
- Von Mises (Max) Stress: 29 MPa
- Yield Stress of PLA: 60 MPa

Von Mises Stress is less than Yield, so material will not break

Conclusion

Damage-reducing parts can protect damage-prone and expensive parts

- Parts may be designed to fail to protect more costly components
- Flawed design can cause failure
- Improper fabrication causes failure

Next Steps

Reiterate, test, and design new and existing parts in flight tests

- Compare different fabrication methods
- Develop different solutions to prevent drone damage from outside sources
- Flight test all existing parts

Mission Relevance

- More efficient radiation monitoring
- Modular and reproducible design helps educational outreach
- Individuals with skills in CAD modeling, additive manufacturing, finite element analysis, design

Expected Impact

- iRAD methodology widely deployed widely to collect radiation background data and mapping
- Build-your-own drone and sensor packages for high schools and colleges

MTV Impact

- Research experience
- Workshop participation and presentation
- Student funding
- Supplies

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