GALLOGLY COLLEGE OF ENGINEERING
AEROSPACE AND MECHANICAL ENGINEERING
The UNIVERSITY *of* OKLAHOMA

GALLOGLY COLLEGE OF ENGINEERING
SCHOOL OF COMPUTER SCIENCE
The UNIVERSITY *of* OKLAHOMA



AME Advisor

Design and Implementation of a Six-DOF Stewart Platform for Autonomous Mini-Drone Recovery and Recharging

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Project Sponsor

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Background & Motivation

Why This Platform?

Overall Goal

- Deploy and recover **mini-drones** autonomously from a **mother drone** carrier system
- Actively compensate for **dynamic landing conditions** using a **six-DOF Stewart platform**

Purpose

- Advance the reliability and safety of **autonomous UAV operations**
- Validate a **motion-controlled landing platform** for next-generation **unmanned aerial systems**



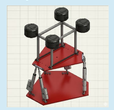
Lufthansa A320-200 Full Flight Simulator – industrial application of Stewart platform technology
Source: Lufthansa Aviation Training GmbH, Munich, Germany

Promised Deliverables & Constraints

Project Scope



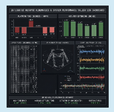
Improved Stewart Platform sacrificial top plate



Drone carrier & pod system



Modular, maintainable control box



Integrated system performance validation

Constraints: *Top plate yields before 35 lbf actuator load · Control box uses standardized connections · System maintains stability under dynamic motion*

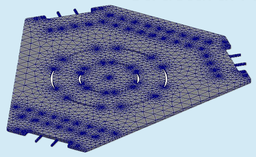
Codes & Standards

Engineering Standards Applied

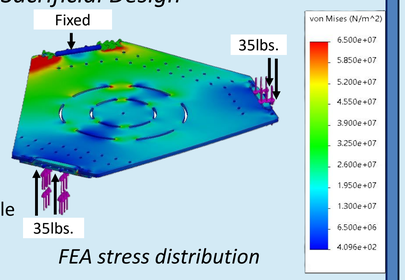
- **ASME B1.1** — Unified Inch Screw Threads
- **ASME Y14.100** — Engineering Drawing Practices
- **UL 508A** — Industrial Control Panels
- **ASTM F3266** — Standard Specification for Small Unmanned Aircraft Systems (UAS)
- **ASTM D4802** — Standard Specification for Acrylic Sheet

Top Plate Redesign & FEA

Structural Analysis & Sacrificial Design



Top plate CAD model



FEA stress distribution

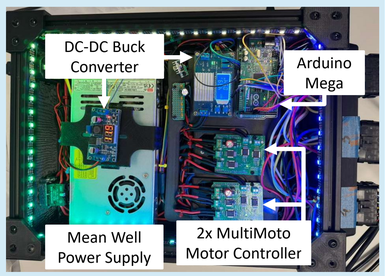
Scenario: Simulates a **single actuator failure** while the remaining actuators maintain movement.

- **Max Actuator Load:** 35 lbf
- **PMMA Acrylic Yield Strength:** 60 - 70 MPa
- **Result:** Top plate yields **before actuator damage** - sacrificial design validated

Circuitry & Case Design

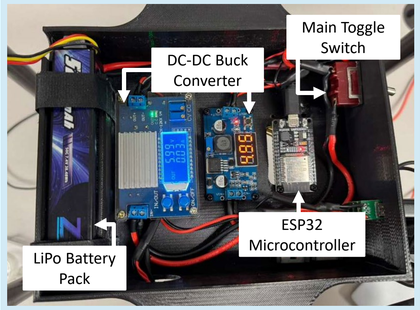
Electrical System Redesign

Stewart Platform



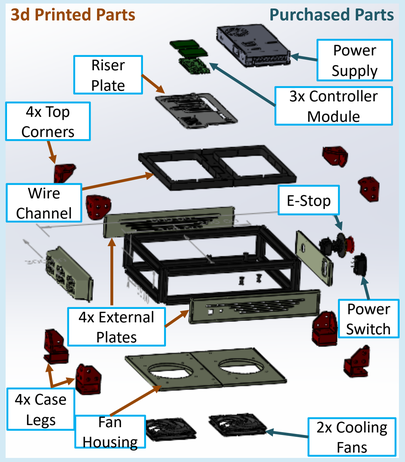
- **Organized lever-lock wiring** — modular, tool-free maintenance
- **Dual MultiMoto motor controllers** — precise independent control of six actuators
- **Mean Well 12V/29A power supply** — stable power delivery across all components

Mini-Drone Recovery & Recharging Platform



- **LiPo battery pack** — compact, lightweight onboard power source for mini-drone operations
- **ESP32 microcontroller** — onboard wireless communication for drone-to-platform connectivity

Modular Enclosure Architecture



Stewart Control Box — Exploded Assembly View



Modular T-Slot Frame
Slotted rail assembly enabling easy upgrades and expansion



PETG Components
Custom-geometry printed parts enabling rapid design iteration



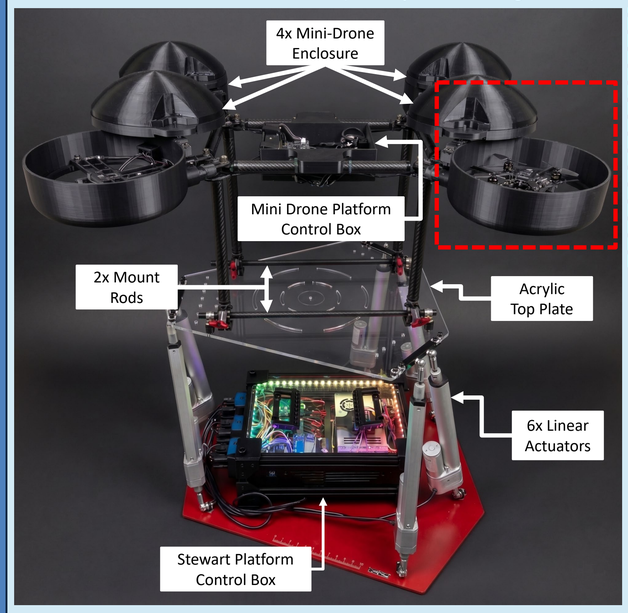
Slide-In Panels
Panels slide along rails for efficient access and maintenance

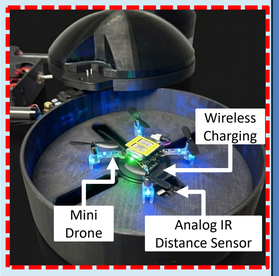


Layered Stacking
Layered frame design maximizes space and component access

Final Prototype

Assembled Stewart Platform with mini-drone (Full system integration)





Features:

- Emergency stop *(Mushroom kill switch)*
- Dual active cooling fans *(Bottom intake, side exhaust airflow)*
- LED status strip *(real-time visual system feedback)*
- Voltage display module *(real-time power monitoring)*
- Lever-lock wiring connectors *(modular, tool-free maintenance)*

Control Software & GUI

Real-Time Diagnostics Dashboard & Operator Interface



- **Platform Pose** — live 6-DOF position monitoring
- **Deep Telemetry** — actuator velocity, acceleration, and saturation tracking
- **Motion Controls** — Start, Stop, Center, Calibrate commands
- **Arduino Log** — real-time system debugging

Future Work & Acknowledgement

Future efforts are encouraged to finalize the **drone carrier enclosure geometry**, implement robust **client-server communication** between the **mother drone** and **mini-drones**, and validate **platform performance** through **ground-based testing** before **airborne integration**. A **weather-resistant control enclosure** and **standardized mini-drone hardware** with **universal wireless connectivity** are recommended for seamless **system integration** and scalability.

Demonstration Video

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