UCI Samueli School of Engineering

Mag-Vengers

Project Summary

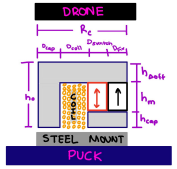
Mag-Vengers aims to advance drone functionality through the use of electropermanent magnets (EPMs). The team is developing a lightweight, durable drone attachment system embedded with EPMs to create a strong, switchable magnetic latch. Controlled electronically, the latch can be turned “on” or “off” to securely hold and individually release six (or more) sensor pucks during high-speed flight.

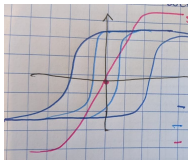
The project’s goal is to deliver a fully functional prototype that is reliable, aesthetically clean, and easy to modify for future teams or organizations. The team aims to have two completed prototypes to present at the Winter Design Fair of 2025.

Magnetic Sub-System

Components:
1. Hard Magnets (Fixed and Switch)
2. Soft Magnet

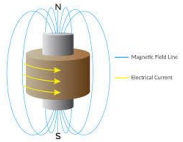
Requirements:
1. Minimum holding force of at least 2.4 Newtons
2. Must be made of a ferromagnetic material, such as AlNiCo for the switch magnet and NdFeB for the fixed magnet
3. Shall have high retentivity and high coercivity





Coil Sub-System

Components:
1. Core
2. Winding Wire



Requirements:
1. Shall have a minimum electric pulse of 20A
2. Shall withstand vibration of 200 Hz
3. Shall not exceed temperature of 100°C
4. Shall have 5 coils and 10 rows

Attachment Sub-System

Components:
1. Steel Mount
2. Puck to Drone Carrier

Requirements:
1. Attachment shall be able to hold 6 pucks moving at 70-120 mph without unintentional detachment
2. Attachment system and steel mount shall be securely attached accordingly.
3. Total mass of carrier and pucks shall not exceed 10% of the drone’s rated payload capacity.
4. Attachment shall not interfere with other components of drone.

Overall System Requirements

- Minimum payload of 46.2 oz.
- Securely hold a stack of six pre-existing pucks, each approximately 1 inch thick, 4 inches in diameter, and 7 oz in weight.
- Utilize Electro Permanent Magnetic technology to catch and release of pucks one at a time utilizing magnetic on/off capabilities.
- Comply with SWaP (Size, Weight, and Power) limitations defined by the Department of Defense standards.
- Consistent magnetic strength under dynamic conditions.
- Magnetic attachment must be robust enough to handle drone movement at 70-120 mph with >80% success rate without any unintentional detachment or displacement.

Milestones and Deliverables

Fall W5-6
- Lab Safety Training
- Coil Calculation for first Prototype
- Simulate Magnet Materials
- Design Testing Procedure for holding force
- CAD Design

Fall W7-8
- First Coil Prototype
- Use COSMOL to simulate different ratios of materials
- 3D print magnet and measure magnetic properties

Fall W9-10
- Finalize first EMP Prototype
- Measure properties and compare with simulation
- Analyze performance and identify improvements needed

Fall Finals
- Develop plan for Winter Quarter
- Document test results and conclusions
- Begin next iteration of design

Winter W3/4
EPM Prototype 2

Winter Week 5
Evaluate & Iterate

Winter Week 9
Final Prototype

Winter Week 10
Winter Design Review

Current Concept(s)