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RELATABLE UAVs

1.1 Anduril's Anvil

The Anduril Anvil is a cutting-edge quadcopter UAV designed to neutralize other drones through kinetic interception. Specifically engineered for use in defense scenarios, the Anvil's key functionality involves ramming hostile UAVs at high speeds, disabling them without the use of explosives. (*Anvil - Counter-UAS Kinetic Interceptor 2024*)

1.1.1 Specs

- **Max Speed:** 90+ m/s
- **Flight Time:** Limited (short-duration missions)
- **Payload:** Kinetic interception mechanism (no explosives)
- **Sensors:**
 - Radar
 - Electro-Optical/Infrared (EO/IR)
- **Autonomy:** Capable of autonomous detection and interception of enemy UAVs
- **Operating Range:** Short-range engagements
- **Design:** Small form factor for rapid deployment
- **Operational Environment:** Designed for defense scenarios in crowded areas

1.1.2 Inspiration to Our Mission Requirements

The Anvil's kinetic interception mechanism is particularly noteworthy, as it disables hostile drones through physical destruction. This aerial impact generates debris that could pose additional risks, although minimized compared to the original threat, to large crowds.

Incorporating a similar high-speed ramming capability into our UAV would allow us to achieve a high kinetic energy to deny enemy quadcopter drones. However, the Anvil's limited endurance, designed for rapid, short-duration intercept missions, differs from the continuous loitering requirement of our mission. To meet our needs, our UAV would need an improved power system or swappable batteries to extend its operational

time beyond the Anvil's capabilities. This could involve adapting the Anvil's efficient interception technology but improving endurance through more energy-dense battery systems or lighter, more efficient construction materials.



Figure 1.1: Anduril's Anvil. (*Anvil - Counter-UAS Kinetic Interceptor 2024*)

1.2 EDGE Group's Hunter 2-S

The Hunter 2-S UAV by EDGE Group is a small, loitering munition designed for engaging targets after extended loitering periods. This capability closely aligns with our mission profile, where the UAV must loiter over a large area before engaging a hostile UAV. (*Hunter 2-S - Loitering Munition UAV 2024*)

1.2.1 Specs

- **Max Speed:** 41.7 m/s
- **Endurance:** Up to 120 minutes of continuous loitering
- **Range:** 50 km operational range
- **Payload:** High-explosive warhead for precise strikes
- **Sensors:**
 - Electro-Optical/Infrared (EO/IR)
 - Advanced Guidance Systems
- **Launch System:** Can be launched from a fixed or mobile platform
- **Autonomy:** Autonomous loitering and engagement capability

1.2.2 Inspiration for Our Mission Requirements

The Hunter 2-S offers several features that directly align with the requirements of our mission, particularly in terms of loitering and engagement capabilities. Its endurance of up to 120 minutes exceeds the hour-long loitering requirement set for our UAV, which could provide valuable insights into how to extend the loiter time of our own design.

The Hunter 2-S is also equipped with autonomous loitering and engagement features, which can serve as inspiration for the autonomous capabilities of our UAV. The ability of

the Hunter 2-S to detect and engage targets with minimal human intervention mirrors the operational autonomy that is crucial to our mission. Incorporating similar levels of autonomy would allow our UAV to patrol large areas, identify hostile UAVs, and engage them efficiently.



Figure 1.2: EDGE Group's Hunter 2-S. (Hunter 2-S - Loitering Munition UAV 2024)

1.3 MARSS Interceptor-MR

The MARSS Interceptor-MR is a high-speed UAV designed to intercept and neutralize airborne threats through kinetic impact. Like the Anvil, the Interceptor-MR uses physical force to disable enemy drones without relying on explosives, making it suitable for use in sensitive environments such as crowded events. (*Interceptor-MR - Autonomous Kinetic Interceptor 2024*)

1.3.1 Specs

- **Max Speed:** Up to 75 m/s
- **Endurance:** Optimized for short-duration, rapid intercept missions
- **Range:** 5 km
- **Payload:** Kinetic interceptor (no explosives)
- **Sensors:**
 - Radar for threat detection
 - Electro-Optical/Infrared (EO/IR) for targeting
- **Autonomy:** Semi-autonomous, with precision guidance for interception

1.3.2 Inspiration to Our Mission Requirements

The Interceptor-MR shares the same kinetic interception philosophy as the Anvil, where hostile drones are physically disabled via high-speed collision. This aligns well with our requirement for neutralizing enemy UAVs in a non-explosive manner, minimizing the risk of collateral damage to civilians.

However, the Interceptor-MR operates at a slightly lower maximum speed (75 m/s compared to the Anvil's 90+ m/s), which still provides sufficient kinetic energy for disabling most consumer-grade UAVs. The Interceptor-MR's range (5 km) is better suited for rapid, short-range engagements, similar to the Anvil, but both UAVs lack the necessary endurance for our mission's continuous loitering requirements.



Figure 1.3: *MARSS Interceptor-MR.* (MARSS Interceptor-MR Killer Drone Close to Production 2023)

TECHNOLOGIES

2.1 Anvil's Sensor Package

The ability to autonomously identify and track enemy UAVs is critical for the success of our mission, and the Anvil's advanced sensor package provides an excellent foundation for this. (*Anvil - Counter-UAS Kinetic Interceptor 2024*)

2.1.1 Sensor Components

- **Radar:** Small form factor (SFF) radar provides long-range detection of airborne threats, even in cluttered environments. This radar system is capable of identifying enemy UAVs with a high degree of accuracy, which is essential for targeting and tracking moving objects.
- **Electro-Optical/Infrared (EO/IR) Sensors:** These sensors provide both visual and thermal imaging capabilities, enabling the Anvil to operate in a wide range of lighting and weather conditions. By using EO/IR sensors, our UAV could track UAVs that are visually obscured or operating in low visibility conditions, enhancing its operational flexibility.

2.2 Portable 12 Bands Jammer (12W)

The Portable 12 Bands Jammer (12W) offers a versatile, non-kinetic solution for disabling enemy UAVs by jamming their communication and navigation systems. This jammer can interfere with a wide range of drones, forcing them to lose control or return to their point of origin. In our mission, this jammer could be deployed as a payload onboard our UAV, allowing it to approach and follow hostile drones while continuously jamming their signals. (*Portable 12 Bands Jammer (12W) 2024*)

2.2.1 Jammer Components

- **Power Output:** 12W total output, capable of jamming signals up to 20 meters.
- **Frequency Bands:** Covers 12 bands including GPS, GSM, 3G, 4G, 5G, and Wi-Fi, ensuring broad-spectrum disruption of UAV communications.

- **Battery Life:** Operates for approximately 90 minutes on a full charge.
- **Design:** Lightweight and portable, allowing for easy integration with small UAVs.

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