Temasek Defence Systems Institute

A SYSTEMS ANALYSIS OF ENERGY USAGE AND EFFECTIVENESS OF A COUNTER-UNMANNED AERIAL SYSTEM USING A CYBER-ATTACK APPROACH

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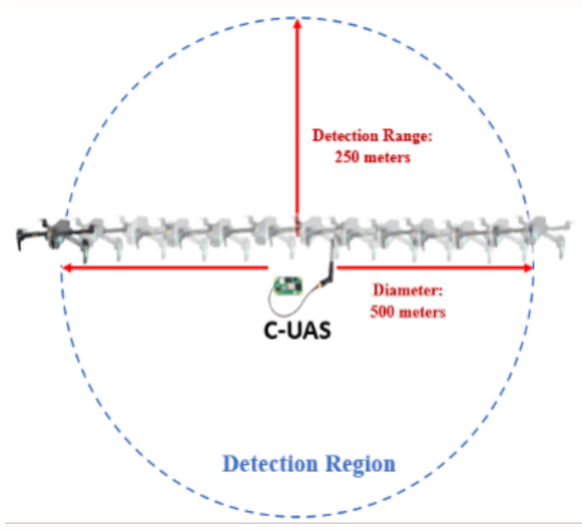
1. Thesis Objectives

Existing counter-unmanned aerial systems (C-UAS) rely heavily on radio frequency (RF) jamming techniques that require a large amount of energy. RF jamming results in undesirable consequences such as jamming nearby friendly devices as well as increasing RF footprint of local operators. Current cybersecurity analysis of commercial-off-the shelf (COTS) UAS have revealed vulnerabilities that can be used to conduct C-UAS operations in the cyber domain via cyber-attacks which hijack device-specific communication links on narrow RF bands. This thesis validates the cyber-attack C-UAS (CyC-UAS) concept through reviewing recent C-UAS operational experimental scenarios and conducting analysis on the collected data.

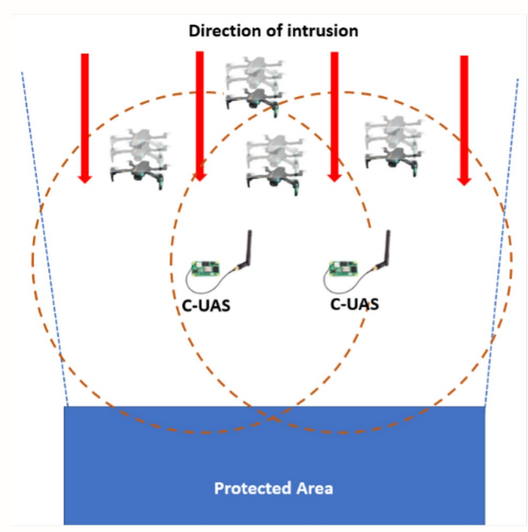
2. Research Method

Experiment scenarios were designed based on the information required to validate the performance of the CyC-UAS system at various ranges and altitudes. Then, a simulation model of a defense facility is constructed to analyze and validate specific mission scenarios and several proposed Concepts of Operation (CONOPS). A comparison of the energy requirements between CyC-UAS and existing C-UAS techniques is performed to assess energy efficiency and trade-offs of different C-UAS approaches.

Experiment Scenario:



Simulation Model:

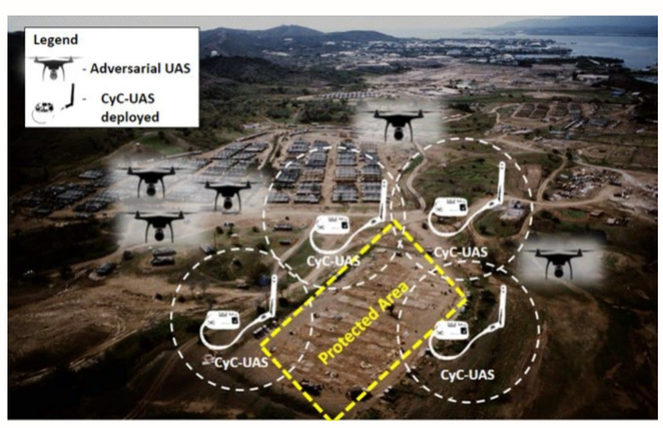


3. Research Results

The comparison of energy requirements between the CyC-UAS prototype and existing C-UAS RF jamming products shows CyC-UAS has significant energy savings while not affecting other telecommunication devices operating at the same frequencies. CyC-UAS is able to achieve the same mission by consuming much less energy and shows promise as a new, lower energy, and lower collateral damage approach to defending against UAS. A CyC-UAS simulation model deployed within a defence facility revealed the system performance as well as the estimated overall energy consumptions during the entire C-UAS campaign.

4. Proposed CONOPS

In the defensive deployment scenario, the mission of the CyC-UAS is to prevent the infiltration of adversarial UAS within a defined protected area to protect a specific installation or infrastructure. In this setup, several CyC-UAS are deployed in stationary positions to defend against infiltration of adversarial UAS into the protected area



5. Benefits/Potential Applications of Research

The identification of operational and technical advantages of CyC-UAS enables the MINDEF SAF to overcome specific challenges faced during C-UAS operations. These include (1) the reduction of electrical power requirements for C-UAS techniques that currently are reliant on significant energy being available, (2) achieving a C-UAS mission without collateral impact on friendly RF telecommunications equipment, as well as (3) minimizing the RF footprint in the area of operation. The realization of the cyber-attack technique on C-UAS operations, together with the recommended CyC-UAS CONOPS (Defensive and Aggressive deployment) presented in this thesis, may enhance MINDEF SAF overall combat capability to counter adversarial UAS.

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