



NATIONAL CYBER SUMMIT

June 4-6, 2019 | Huntsville, AL

Faster than the Speed of Threat:
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Unmanned Aerial Vehicles (UAVs) Threat Analysis and a Routine Activity Theory based Mitigation Approach

Alan Roder and Kim-Kwang Raymond Choo



Paper Summary

The paper seeks to discuss the following topics;

- The difference between a UAV and a Drone
- How UAVs are being used as the target of crime/nefarious activity.
- How UAVs are being used to facilitate crime/nefarious activity.
- UAV crime prevention strategies
- Threat analysis for 2019



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About the Authors

Alan Roder

- MSc – Computer Forensics and Cybercrime investigation
- British Army 4 years
- Police Officer 11 years
 - i. Criminal Investigations 7 years
 - ii. Digital Forensic Specialist 4 years
 - i. UAV Forensic Specialist 3 years

Kim-Kwang Raymond Choo

- Ph.D. in Information Security
- Currently holds the Cloud Technology Endowed Professorship at The University of Texas
- Former Police Officer in Singapore for 5 years

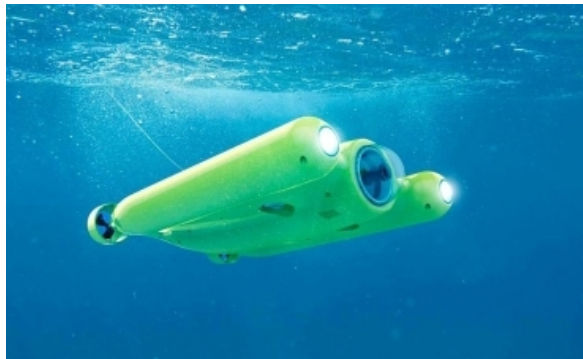


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UAV vs Drone – What's the difference?





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UAV vs Drone – What's the difference?

- Drone is a term used to describe any pilotless vehicle.
- A Drone can be controlled either remotely, or autonomously through a pre-programmed destination.



UAV vs Drone – What's the difference?

- UAV (Unmanned Aerial Vehicle) is the term which best encompasses any remote controlled aeroplane, which also encompasses quadcopters.
- UGV (Unmanned Ground Vehicle) is the term which best encompasses any remote controlled land based vehicle.
- USV (Unmanned Sailing Vehicle) is the term which best encompasses any remote controlled vessel, which sails on the water.
- UUV (Unmanned Underwater Vehicle) is the term which best encompasses any remote controlled vessel, which sails below the water.
- UOSV (Unmanned Outer Space Vehicle) is the term which best encompasses any remote controlled vehicle in outer space.



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UAVs are the target of a crime/nefarious activity.

- UAV price brackets vary, but mid range models range between £400-£1200.
- Use of a stolen may throw law enforcement off during a criminal investigation.
- Pilots subject to assault.
- Potential avenue for research, as there are no published works in the field of study.



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Criminal or nefarious activities involving UAVs

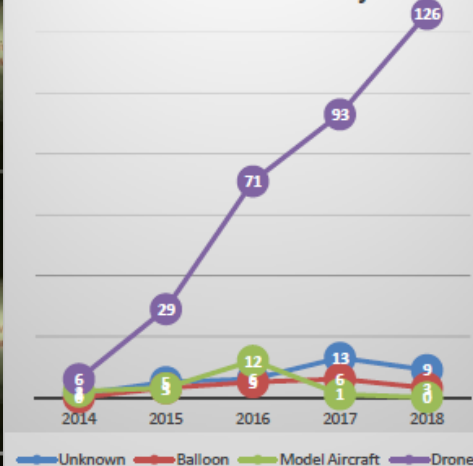


Breaching airspace

- Breaching airspace – UAV flights into civil and military airspace have become a significant risk to flight safety in recent years, with multiple reports of ‘near-miss’ events involving UAVs and passenger jets.



Airprox. Reports Involving
Drones and Other Objects





Breaching airspace

Routine Activity Theory:

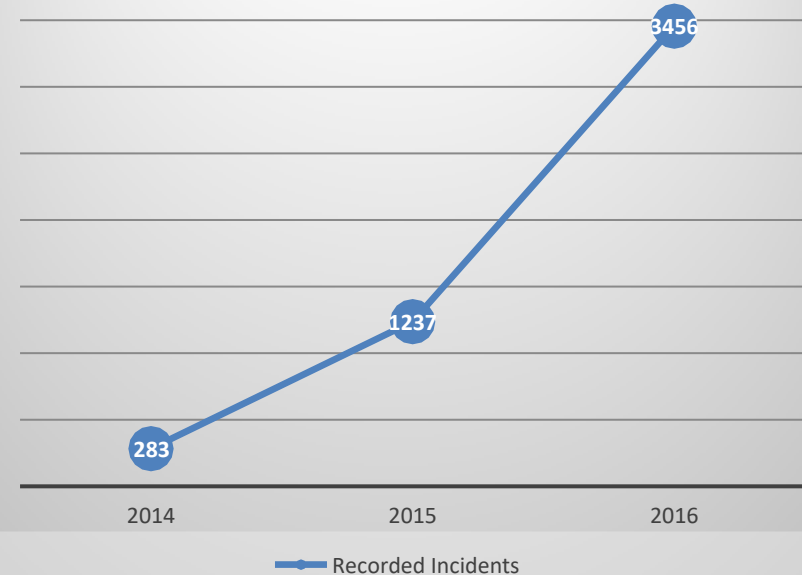
- Most airspace is considered 'unrestricted'.
- Enforcement of laws are limited due to a lack of registration.
- Offenders are likely those pilots who are either unaware or ignore CAA laws.
- Since most airspace is classed as 'unrestricted', locations in which breaches can occur are numerous.
- Since no detection system is present for the majority of airspace, pilots can fly with relative anonymity.



Public Disorder/Noise Disturbance

- Typically, 'off the shelf' UAVs generate noise.
- Under reported offence.
- Police reports for incidents logged involving 'Flying gadgets' have risen between 2014 and 2016.
- UAVs can be flown with relative anonymity.

UAV recorded Incidents (UK)





Public Disorder/Noise Disturbance

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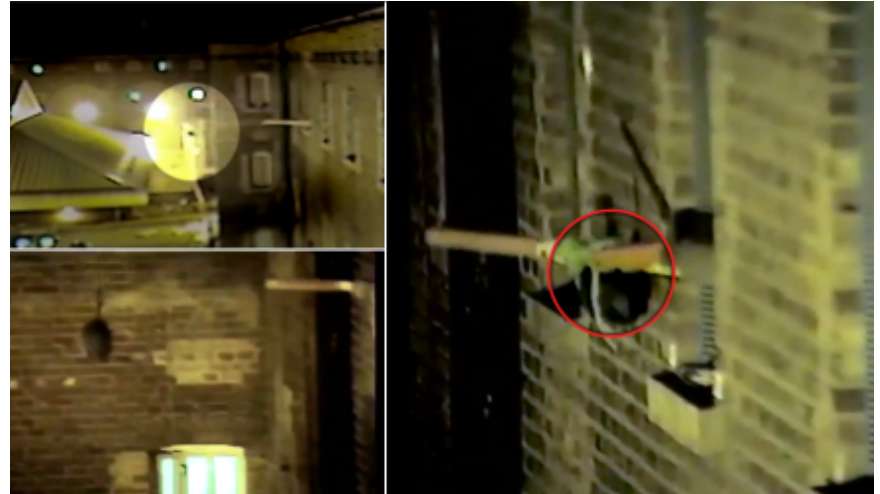
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Bringing items into restricted areas

- Bringing items into restricted areas
 - Whilst there are many restricted areas within the UK, this offence appears to primarily focus on flying illegal or banned items into prisons.

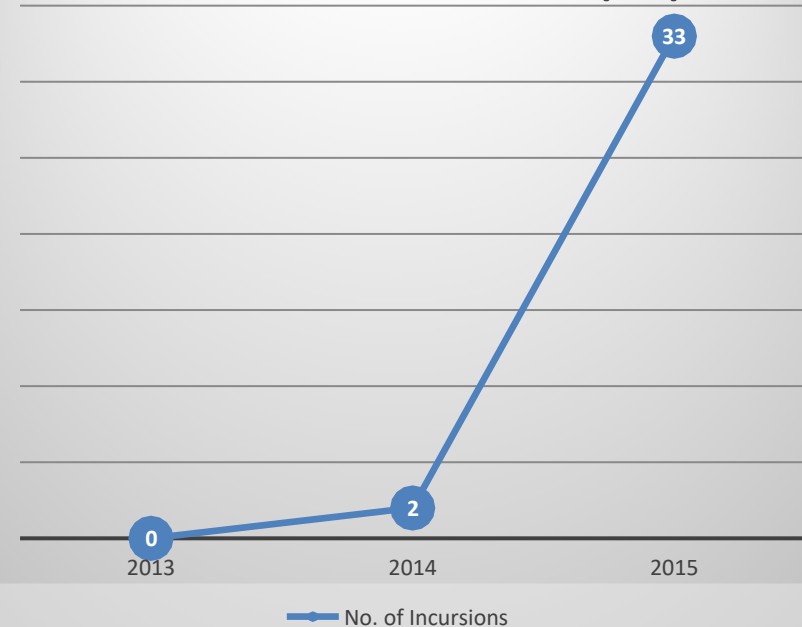




Bringing items into restricted areas

- A Freedom of information act request to the Ministry of Justice identified in increase in UAV incursions into prisons between 2014-2016.
- A request for statistics between 2016-2018 was refused by the Ministry of Justice.
- Recent high profile convictions appear to have reduced re-offending.

UAV recorded Incidents (UK)





Bringing items into restricted areas

- Whilst trials are underway, currently there is no monitoring system in place to identify UAVs flying across a prison perimeter.
 - Using UAVs is currently low risk/high reward endeavour, with operators paid up to £1000 per flight.
- Routine Activity Theory:
- Offenders are likely obtaining financial gain.
 - Since most airspace is classed as 'unrestricted', locations in which breaches can occur are numerous.
 - Since no detection system is present for the majority of airspace, pilots can fly with relative anonymity.



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Voyeurism

- Voyeurism – Voyeurism is the act of viewing someone conduct a private act without their knowledge.





Voyeurism

- By its very nature, voyeurism is an under reported crime.

Routine Activity Theory:

- Offenders are likely those pilots who wish to obtain sexual gratification.
- Since most airspace is classed as 'unrestricted', locations in which breaches can occur are numerous.
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Assault

- Assault – An assault is committed when a person intentionally or recklessly applies unlawful force to another.





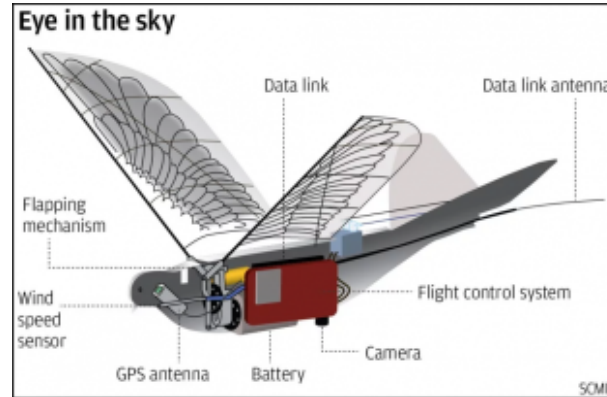
Assault

- ‘Off the shelf’ features now include;
 - ‘Follow-Me’
 - Increased stabilisation
 - Increased flight time
 - Advanced collision avoidance
 - Enthusiasts have successfully attached firearms to UAVs.
 - UAVs can be flown without registration.
 - Large public gatherings are unlikely to be in an area with UAV monitoring.
- Routine Activity Theory:
- Offenders are likely those pilots with a specific grievance against a person, group or organisation.
 - Since most airspace is classed as ‘unrestricted’, locations in which breaches can occur are numerous.
 - Since no detection system is present for the majority of airspace, pilots can fly with relative anonymity.



Surveillance/Counter-surveillance

- Obtaining detailed and up to date information on national assets and infrastructure.





Surveillance/Counter-surveillance

Surveillance prior to;

- An attack
- A burglary
- During voyeurism
- Protect land

Counter surveillance to;

- Prevent an attack (Minimise risk)

Routine Activity Theory;

- Offenders may have criminal, voyeuristic or nefarious intentions, or may acting on behalf of a nation state.
- Since most airspace is classed as 'unrestricted', locations in which breaches can occur are numerous.
- Since no detection system is present for the majority of airspace, pilots can fly with relative anonymity.



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Terrorism

- Terrorism – An act committed by a group or organisation to intimidate or commit fear.





Terrorism

ISIS have;

- Used UAVs since 2014.
- Threatened to use UAV during the 2018 World Cup in Russia.
- Recently threatened to attack the Eiffel Tower

UAVs are;

- Adaptable.
- Able to carry light loads (Including ordinance, drugs and firearms).

Routine Activity Theory;

- Offenders may have criminal or nefarious intentions, or may acting on behalf of a nation state.
- Since most airspace is classed as 'unrestricted', locations in which breaches can occur are numerous.
- Since no detection system is present for the majority of airspace, pilots can fly with relative anonymity.

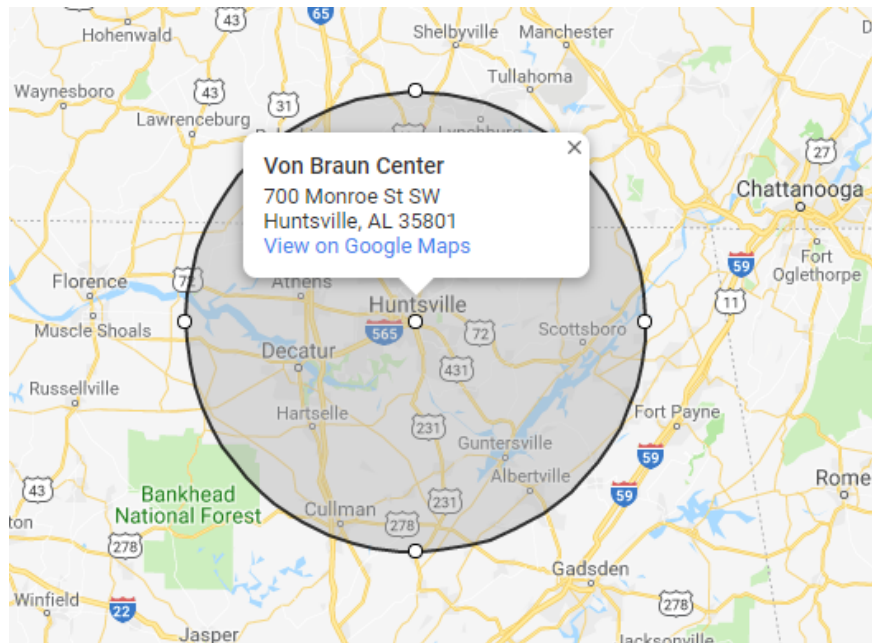


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Terrorism

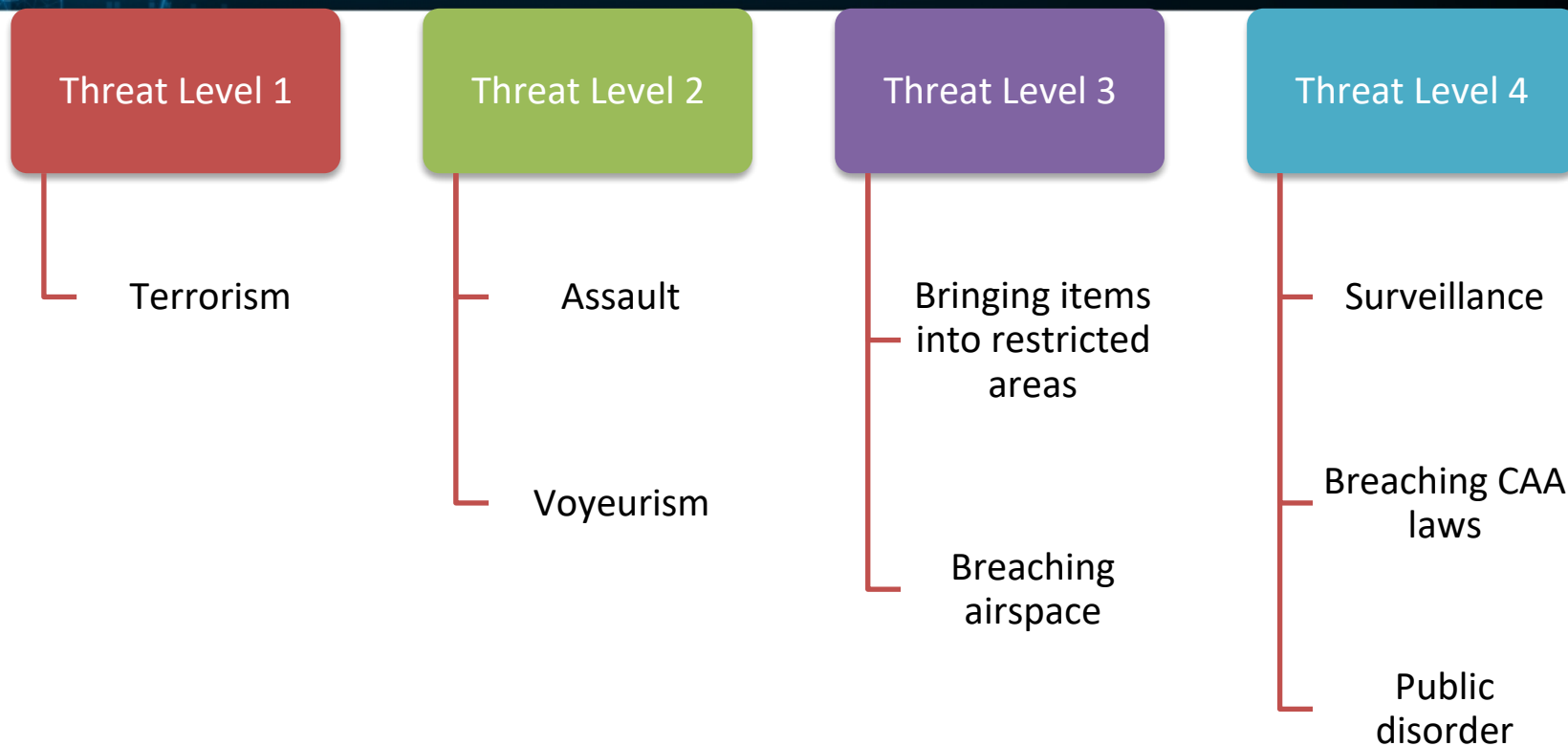




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Routine Activity Theory

- Key theoretical approach to criminology, which identified that people act in response to situations.
- The model identifies that a criminal act occurs as a result of the merging of three key elements;
 - Motivated offender
 - Suitable Target
 - Lack of Guardianship



Routine Activity Summary

- Whilst CAA laws are designed to promote safer flight, in reality there are insufficient mechanisms in place to identify breaches.
- Large sections of UK airspace is classed as 'Unrestricted'. Unrestricted airspace usually contains no Aircraft Control Zone (ATZ).
- Currently there is no national model for implementing a UAV detection system, specifically around large populations, national infrastructure and sensitive locations.
- UAVs do not require registration of ownership, as such in the limited cases where UAVs have crashed after committing a crime, investigations can prove time consuming and may not identify an owner.
- UAVs do not require insurance for recreational flight.



UAV crime prevention strategies

UAV Pilots licence

- Currently UAV pilots are not required to hold a licence to fly UAVs
- Recreational pilots are not required to pass a test or show an understanding of CAA laws.
- Commercial pilots are required to have completed a PfCO (Permission for Commercial Operations) by a recognised training establishment.



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UAV crime prevention strategies

Creating a UAV Pilots licence will;

- Promote safe practice.
- Assist law enforcement in identifying and prosecuting illegal activity.
- Create a legitimate career path for an emerging market.



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UAV crime prevention strategies

UAV Insurance and Registration

- Insurance is required for commercial flight/Operations
- No insurance is necessary for recreational flights



UAV crime prevention strategies

Implementing UAV Insurance and Registration will;

- Making UAV registration mandatory would make the owner liable for its use
- Law enforcement agencies would have powers to seize unregistered UAVs
- By creating a UAV pilots licence, with the supporting framework of insurance and registration, the opportunity to commit crime with relative anonymity would be greatly reduced.



UAV crime prevention strategies

Networked UAV detection system around key locations, sensitive sites and national infrastructure.

- Would provide early warning of unregistered UAVs entering airspace.
- Threat assessment and action could be taken against Unregistered UAVs.
- Flight path data could be used by law enforcement in the event of a suspected criminal offence where a UAV was used.

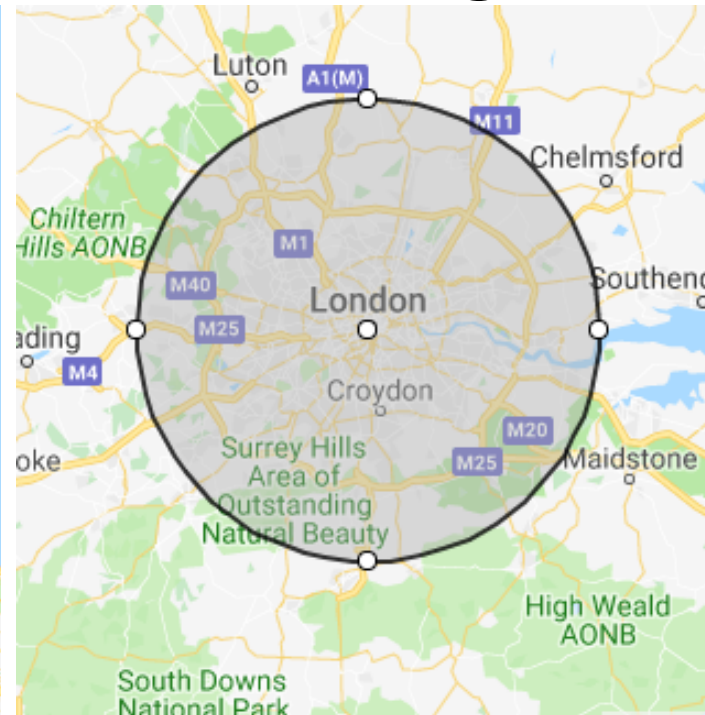


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UAV crime prevention strategies



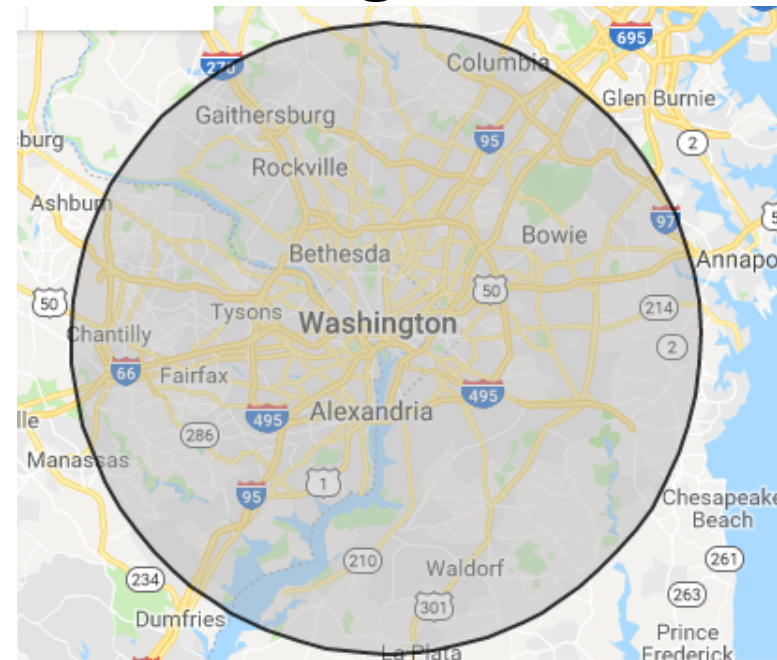


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UAV crime prevention strategies





Threat analysis

A UAV related strike on an aircraft;

- Near miss reports involving UAVs and aircraft has increased year on year.
- The number of UAVs being flown (Commercial and recreational) is increasing.
- Recreational UAV pilots may not understand the laws or risks associated to UAV flight, thereby increasing the risk of a collision.
- Research by the University of Dayton confirms the impact damage which could be caused.
- The likely hood of an aircraft strike involving a UAV in a first world country is considered high.



Threat analysis

A UAV related criminal act;

- Criminal activity involving UAVs has consistently increased year on year.
- UAV capability and functionality has increased
- With superior recording equipment there is a greater risk of voyeuristic style offences.
- With greater range and flight time there is a greater risk of surveillance style offences.
- The likely hood of a criminal act involving a UAV in a first world country is considered high.



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Threat analysis

A terrorist act within a first world country;

- UAVs are recorded to have been used by terrorist organisations since 2014.
- UAVs provide an inexpensive method of payload delivery with limited risk.
- UAV capability and functionality has increased
- With greater adaptability UAVs can be used to target individuals and/or groups.
- With ISIS failing in Syria, it is likely the organisation will filter back into the general population.
- The likely hood of a terrorist act involving a UAV in a first world country is considered high.



Conclusion and future work

- The increased use of UAVs is almost inevitable. Rather than try to prevent their use, it would be more productive to work with industry experts and enthusiasts to design a framework for lawful use which is robust and achievable for law enforcement agencies to act on.
- Based on findings from this research, we posit the importance of undertaking further study to better understand the global crime and terrorist threats through the use of UAVs.
- A globally unified approach for intelligence gathering and sharing is also essential for each nation state, and necessary for accurate and intelligence lead dissemination of information.



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Any questions

